DOE/OR/11-3137&D3
6/20/2005

2005 Annual
End State Vision
for the
Portsmouth Gaseous Diffusion Plant,
Piketon, Ohio

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2005 Annual End State Vision for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

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Science Applications International Corporation
Dublin, Ohio

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BECHTEL JACOBS COMPANY LLC
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Science Applications International Corporation

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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FIGURES

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ACRONYMS

ACO	Administrative Consent Order
ACL	alternate concentration limit
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirements
ASER	Annual Site Environmental Report
ASTM	American Standards and Testing Materials
BAT	best available technology
BERA	Baseline Ecological Risk Assessment
BJC	Bechtel Jacobs Company LLC
B&R	Budgetary and Reporting
CAS	cleanup alternative study
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CMI	corrective measures implementation
CMS	corrective measures study
CPCB	chemical and petroleum containment basins
CSM	conceptual site model
D&D	decontamination and decommissioning
DEM	Digital Elevation Model
DFFO	Director’s Final Findings and Orders
DMSA	DOE material storage area
DNAPL	dense non-aqueous phase liquid
DOE	United States Department of Energy
DUF_6	depleted uranium hexafluoride
EA	Environmental Assessment
EM	Department of Energy Office of Environmental Management
EPA	United States Environmental Protection Agency
ES	End State
ETTP	East Tennessee Technology Park
ft	feet
ft^2	square feet
FS	Feasibility Study
FY	fiscal year
GCEP	Gas Centrifuge Enrichment Plant
GDP	Gaseous Diffusion Plant
GIS	geographical information system
HEU	highly enriched uranium
HI	hazard index
HSWA	Hazardous and Solid Waste Amendments
HWMU	hazardous waste management unit
ISWL	industrial solid waste landfill
LCB	Life-Cycle Baseline
MCL	maximum contaminant level
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
MW	Megawatt
NEPA	National Environmental Policy Act

ACRONYMS

NFS	Nuclear Fuels Service
NPDES	National Pollution Discharge Elimination System
NPL	National Priority List
NRDA	Natural Resource Damage Assessment
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
ORC	Ohio Revised Code
OVEC	Ohio Valley Electric Corporation
PAH	polynuclear aromatic hydrocarbon
PBS	Project Baseline Summary
PCB	polychlorinated biphenyl
pCi/kg	picocuries per kilogram
PMP	Program Management Plan
PORTS	Portsmouth Gaseous Diffusion Plant
PPE	personal protective equipment
Ppb	parts per billion
ppm	parts per million
PRG	preliminary remediation goal
psi	pounds per square inch
RBES	Risk-Based End State
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SAIC	Science Applications International Corporation
SODI	Southern Ohio Diversification Initiative
SWMU	Solid Waste Management Unit
TCA	trichloroethane
TCE	trichloroethene
TSCA	Toxic Substance Control Act
TSD	treatment, storage, and disposal
UDS	Uranium Disposition Services, LLC
UF_6	uranium hexafluoride
μg/L	micrograms per liter
USACE	United States Army Corps of Engineers
USEC	United States Enrichment Corporation
USGS	United States Geological Survey
VER	vacuum enhanced recovery
VOC	volatile organic compound
WMU	waste management unit
yd^3	cubic yard

PREFACE

The End State Vision is a living document that will be reviewed, updated, and resubmitted annually, reflecting the continued remediation and public input processes, and any change in the regulatory environment that occurred throughout the preceding year. This includes the status of completed and ongoing cleanup actions at PORTS and input from stakeholder and public meetings and/or workshops regarding future land use that form the basis of the End State Vision. This approach ensures there is continuing opportunity for public and stakeholder participation and input on the evaluation and potential implementation of concepts and/or ideas derived from the ES Vision process.

The revisions made to the May 2004 *Risk-Based End State Vision and Variance Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/OR/11-3137&D1) and *January 2005 Draft End State Vision* (DOE/OR/11-3137&D2) that make up this *Annual 2005 End State Vision* (DOE/OR/11-3137&D3) document are, in part, the result of a United States Department of Energy (DOE) meeting titled *Intergovernmental Meeting on Risk-Based End States* held with various local and national stakeholders in Chicago, Illinois in October 2004. This two-day meeting focused on the future development of the End State Vision throughout the DOE complex.

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EXECUTIVE SUMMARY

This End State (ES) Vision document (formerly Risk-Based End State or RBES) and Variance Report for the Portsmouth Gaseous Diffusion Plant (PORTS) in Piketon, Ohio has been prepared in accordance with the U.S. Department of Energy (DOE) Policy 455.1, entitled *Use of Risk-Based End States,* and subsequent guidance entitled *Guidance for Developing a Site-Specific End State Vision*, *Risk-Based End State Guidance Clarification*, and *Final End States Vision Documents*, dated September 11, 2003, December 23, 2003, and November 12, 2004, respectively. DOE Policy 455.1 and subsequent guidance was developed in response to the February 2002 *Top to Bottom Review of the EM Program*, which recommended moving DOE's Environmental Management (EM) program to an accelerated, risk-based cleanup strategy and aligning the scope of the EM program to be consistent with an accelerated, risk-based cleanup.

DOE's primary objective of the ES Vision process is to evaluate each site consistently across the entire DOE complex to document the current state as of 2005; the current baseline end state per current regulatory agreements; clearly articulate the ES Vision; and identify variances that may exist between the two end states in a single, unified approach. The goal of this document is to comply with the aforementioned DOE Policy 455.1 requirements and to meet these objectives as they relate to PORTS.

The ES Vision document is not a decision document and DOE recognizes that the ES Vision may not agree with existing site compliance agreements and regulations or all stakeholder preferences. It is not the intention of this document to preclude continuing with existing regulatory agreements or to authorize implementation of the variances that may be inconsistent with the existing regulatory agreements, decisions, and/or statutory requirements. Rather, the variances identified in this document become a baseline for evaluation, as appropriate, in future decision documents. In the event DOE chooses to seek changes or approaches stemming from the ES Vision process, it will do so in accordance with all applicable legal requirements.

The ES Vision document is to be developed in cooperation with state and federal regulators and in consultation with affected governments and stakeholders. The initial draft RBES Vision document for PORTS was compiled in January 2004 as a starting point for discussions with such stakeholders. A stakeholder meeting to introduce the RBES process and engage stakeholders in working with DOE on the RBES Vision was held on January 28, 2004 in Piketon, Ohio. Two additional working group sessions were held on February 18 and 24, 2004 to explain the draft RBES Vision document and to provide a forum for stakeholders to ask questions and offer comments on the document. A fourth stakeholder meeting was held on March 23, 2004 to discuss how comments received on the draft RBES Vision document were addressed and incorporated into this document. It should be noted that not all stakeholders agree with the ES Vision. Appendix B chronicles all written comments received, announcements sent, newspaper clippings of announcements, and attendance sheets for each public meeting and workshop throughout the development of the ES Vision document. The End State Vision document is a living document that will be reviewed, updated, and resubmitted annually, reflecting the continued remediation and public input processes, and any change in the regulatory environment that occurred throughout the preceding year. As such, DOE will continue to work with its stakeholders as the ES Vision evolves to ensure there is continuing opportunity for public and stakeholder participation and input on the evaluation and potential implementation of concepts and/or ideas derived from the ES Vision process.

All sites across the country within the DOE complex are completing these ES Vision documents. As prescribed by the guidance provided by DOE, the ES Vision document includes specific information within a regional context, site context, and hazard-specific context for the current state, current baseline end state and the ES Vision. A key component to developing this ES Vision document is the use of the PORTS geographic information system (GIS). The GIS integrates multiple sets of geographically referenced data received from various sources at the site, county, state, and federal levels to create maps that follow a standardized hierarchical approach to depict PORTS within the required contexts. These maps are intended to present and allow comparisons between current and future land use; depict hazards and risks to affected or potentially affected receptors; serve as a decision-making tool for site management; enhance communication of risks during discussions with stakeholders; allow tracking of expected and actual cleanup results; and serve as a communication tool for public meetings in regard to cleanup activities, current PORTS missions, and future land use. The sections in this document have been prepared consistent with all other ES Vision documents being developed throughout the DOE complex. It is DOE's intent to have these ES Vision documents made available on web sites for public review and comment.

PORTS has several ongoing DOE missions: to maintain the uranium enrichment facilities in a cold standby mode for potential restart, if necessary; manage the surplus uranium materials in interim storage; complete environmental cleanup and disposition of legacy waste; and construct and operate a depleted uranium hexafluoride (DUF_6) conversion facility to eliminate hazards and costs associated with continued storage of more than 19,000 DUF_6 cylinders stored at PORTS. It should be noted that, while not an official DOE mission, commercial uranium enrichment should be considered a site mission at PORTS. This is due to: 1) USEC's 2002 announcement of the American Centrifuge Demonstration Facility that will be constructed and implemented by 2005, which will contain a lead cascade of up to 240 centrifuge machines; and 2) USEC's January 2004 announcement of a full deployment of the American Centrifuge Uranium Enrichment Plant to be located at PORTS.

During past PORTS operations, hazardous and radiological constituents were released to the environment. Volatile organic compounds such as trichloroethene (TCE), technetium, polychlorinated biphenyls (PCBs), uranium, and other metals have contaminated the groundwater beneath the site and in some cases exceed drinking water standards.

Environmental restoration activities are being regulated under the corrective action provisions of the Resource Conservation and Recovery Act (RCRA) of 1976 and, with respect to hazardous substances that are not RCRA hazardous waste, the provisions of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1986. PORTS is not listed on the CERCLA National Priorities List. RCRA is the primary regulatory cleanup driver for PORTS. Environmental restoration and waste management activities at PORTS are governed by the following regulatory documents:

- Consent Decree of August 31, 1989. This RCRA driven agreement from the Ohio EPA requires DOE to complete site investigations to determine the nature and extent of any contamination that exists at PORTS, complete cleanup alternative studies, and implement corrective actions as needed;

- Administrative Consent Order of August 11, 1997, which is the US EPA equivalent to the Ohio EPA Consent Decree discussed above;

- Director's Final Findings and Orders (DFFOs) of March 17, 1999, which are orders issued by the Ohio EPA Director for the integration of five RCRA hazardous waste closures into the RCRA corrective action process. This document also allows for integration of the groundwater monitoring and surveillance and maintenance programs associated with units that had been closed under RCRA and Solid Waste rules;

- RCRA Part B Permit, which incorporates the Consent Decree and the 1999 DFFOs, is a RCRA permit regarding storage of hazardous waste in specified areas in the X-7725 and X-326 Buildings;

- DFFOs of October 1995, which are orders issued by the Ohio EPA for the storage of mixed (hazardous and radiological) wastes beyond one year;

- DFFOs of February 1998, which are orders issued by the Ohio EPA for the management of DUF_6 cylinders and lithium hydroxide stored at PORTS; and

- DFFOs of March 2004, which are orders issued by the Ohio EPA Director for the shipment and management of DOT-compliant DUF_6 cylinders being shipped from Oak Ridge, TN to PORTS.

In addition, a number of RCRA closures and interim measures have been completed in accordance with state and federal regulations. PORTS is not a site for which an accelerated cleanup agreement was negotiated, and accordingly, it was not eligible for additional funding identified by Congress as contingent upon an accelerated cleanup agreement.

PORTS has been divided into quadrants for remedial investigation and cleanup. The Decision Documents issued to date by the regulatory agencies address actions in all quadrants and identify those units for which cleanup will be deferred until plant decontamination and decommissioning. The selected remedies consist of extracting and treating contaminated groundwater, capping of landfills and surface impoundments, bio-phytoremediation, subsurface barriers, institutional controls, and innovative remediation technologies such as oxidant injection and hydrogen releasing compounds to destroy contaminants in situ.

Eight hazard areas are identified in this ES Vision document. These hazard areas were developed to be consistent with the PORTS site mission and cleanup strategy. The hazard areas are:

- Hazard Area 1 (Groundwater Plumes and Sources): This hazard area is comprised of the groundwater beneath PORTS and encompasses the sources of contamination to groundwater, the dissolved phase plumes, and dense non-aqueous phase liquid (DNAPL).

- Hazard Area 2 (Surface Soil Contamination and Sources): This hazard area is comprised of units that make up the surface soils. It encompasses all areas containing contamination that do not impact the groundwater or surface water. This hazard area includes all areas inside the industrialized portion of PORTS that are not part of other hazard areas.

- Hazard Area 3 (Landfills): This hazard area is comprised of all closed landfills at PORTS.

- Hazard Area 4 (Legacy Waste and DMSAs): This hazard area is comprised of legacy waste found at storage locations at PORTS and potentially contaminated materials found in DOE Material Storage Areas (DMSAs).

- Hazard Area 5 (Cylinder Yards): This hazard area is comprised of the cylinder yards that contain DUF_6 and a facility currently planned to convert the DUF_6 to more stable uranium oxides before off-site shipment.

- Hazard Area 6 (GDP Facilities): This hazard area is comprised of the Gaseous Diffusion Plant (GDP) facilities and infrastructure that are anticipated to undergo future D&D activities.

- Hazard Area 7 (Surface Water Impoundments): This hazard area is comprised of each surface water impoundment at PORTS. It encompasses the impounded bodies of surface water found within the industrialized portion of PORTS, but does not include creeks and ditches, as they are addressed in a separate hazard area.

- Hazard Area 8 (Surface Water): This hazard area is comprised of surface water creeks and ditches. It encompasses the plant ditches and outfalls found inside the industrialized portion of PORTS and those found outside the industrialized area that run both on and off DOE property.

DOE's long-term vision for the site is evolving and will depend on future decisions by DOE that consider input from its stakeholders. DOE's currently envisioned end state is reflected in the EM's lifecycle baseline. In December 1995, a future land use plan for PORTS was developed that incorporated the regulators' and community's input, entitled *A Report to the U.S. Department of Energy on Recommended Future Uses of the Oak Ridge Reservation, Paducah Gaseous Diffusion Plant, and the Portsmouth Gaseous Diffusion Plant* (*ES/EN/SFP-43/D-1*) (DOE 1995a). The baseline follows the public's recommendation for an industrial land use scenario within Perimeter Road and industrial/ commercial and recreational land uses for the remaining reservation outside the Perimeter Road. A land use study was also prepared by the Southern Ohio Diversification Initiative (SODI), the local community reuse organization (SODI 1997).

With the ongoing DOE missions at PORTS, and expected continued nuclear industrial missions through the advanced centrifuge commercial plant and the DUF_6 conversion plant, the industrial land use scenario is a likely end state land use for PORTS. DOE currently expects future land use at PORTS inside Perimeter Road to be controlled industrial with commercial/recreational land use outside of Perimeter Road. Institutional controls will remain in effect and use of groundwater will continue to be restricted. In addition, Ohio EPA has asked DOE to evaluate land for future Natural Resource Damage Assessment (NRDA) consideration. It is believed that a mutually agreed upon ES Vision can be achieved that will both support critical missions at PORTS and ensure protection of human health and the environment.

The following summarizes the current baseline end state based on current regulatory requirements:

- All land use inside Perimeter Road would continue to be industrial;

- Land use outside of Perimeter Road would be available for large scale office/industrial, rail/industrial, retail and service, or small scale office/industrial (DOE 1995a);

- Institutional controls would remain in effect to control/restrict site access and land use such as at landfills and other solid waste management units (SWMU);

- Protect on- and off-site receptors (human and ecological) from unacceptable exposure;

- Assess risk for human health for each release site (SWMU), utilizing a risk scenario of future on-site worker dermal contact and ingestion of groundwater from beneath the site. A *Plant-wide Baseline Human Health Risk Assessment, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 1995b), which addressed cumulative risk was submitted to the regulators;

- A Baseline Ecological Risk Assessment (BERA) was performed on the impact that releases from the Portsmouth operations currently have or may have on ecological receptors at PORTS. The BERA focused on Little Beaver Creek and Big Run Creek watersheds and the northwestern, western, and southwestern tributaries. End point species for the BERA included aquatic species, terrestrial species, and piscivorous species. Wetlands and threatened and endangered species were also addressed. The BERA concluded that there were no significant impacts that would affect the formulation of end state land uses;

- Continue groundwater extraction and treatment until the maximum contaminant level (MCL) groundwater cleanup standards are achieved throughout the extent of the plume. The point of compliance is the impacted groundwater body of the plume. The Ohio Environmental Protection Agency considers the groundwater to be potable. Therefore, the preliminary remediation goal is to clean the entire plume to drinking water standards (i.e., MCLs). However, groundwater within the DOE property boundary would continue to be restricted by the deed notation currently filed with Pike County; and

- Post-cleanup stewardship would involve risk assessment and would be protective of natural resources. Continued monitoring and engineering controls would be in place to ensure the protection of on-site workers, and the continued protection of the public and the environment.

The following summarizes the ES Vision:

- All land use inside Perimeter Road would be controlled industrial;

- Land use for areas where landfills and groundwater plumes exist outside of Perimeter Road would also be controlled industrial;

- Land use for all remaining areas outside of Perimeter Road would be either commercial or open space/recreational;

- Point of compliance for groundwater would be established at the DOE property boundary, rather than within the body of the contaminated plume to allow for monitored natural attenuation to occur for most plumes (would not apply to X-749/X-120 plume due to its proximity to the property boundary);

- Groundwater within the DOE property boundary would continue to be restricted by the deed notation currently filed with Pike County. Thus, groundwater would continue to not be used for drinking or showering so on-site dermal and ingestion exposure pathways would not be completed, and MCLs would not be applicable.

- A risk range in groundwater of 1×10^{-4} to 1×10^{-6} would be achieved within the DOE property boundary;

- Institutional controls would remain in effect to control/restrict site access and land use such as at landfills and other solid waste management units (SWMU);

- Protect on- and off-site receptors (human and ecological) from unacceptable exposure; and

- Post-cleanup stewardship would involve risk assessment and would be protective of natural resources. Continued monitoring and engineering controls would be in place to ensure the protection of on-site workers, and the continued protection of the public and the environment.

No significant changes in contaminant release, transport, and exposure mechanisms or in receptors were identified between the current baseline end state (based upon current regulatory requirements) and the ES Vision, primarily due to the extent of the cleanup actions already accomplished at PORTS. However, a major difference occurs in the approach for final groundwater cleanup with respect to points of compliance. The variance can be broken down into two categories: physical point of compliance (i.e., where PORTS must determine compliance, such as within the body of the groundwater plume versus the DOE property boundary) and concentration point of compliance (i.e., MCLs or a risk level of $1x10^{-6}$ versus a risk range of $1x10^{-4}$ to $1x10^{-6}$). Chapter 5 of this document details this point of compliance variance in greater detail.

The regulators take the position that: 1) PORTS' groundwater throughout the site is potable and can be used for drinking or showering; and 2) the deed notation currently filed with Pike County that restricts the use of groundwater at PORTS is not recognized as having a bearing on cleanup criteria. Because of these positions, PORTS is subject to drinking water standards. This requires PORTS to calculate risk based upon on-site workers drinking and showering with the groundwater (i.e., dermal and ingestion exposure risk scenarios). Thus, PORTS must attain MCLs (i.e., $1x10^{-6}$ risk level) for all groundwater within the site, including areas of remedial actions throughout each plume within a 30-year period (based on RCRA Corrective Action requirements). In addition, PORTS must employ best available technology (BAT) and as low as reasonably achievable (ALARA) methods to achieve the $1x10^{-6}$ risk level requirement. DOE's position is that the groundwater beneath PORTS has not been used, is not currently used, and will not be used in the future, as the three well fields along the Scioto River will continue to supply water to the site and continue to be treated on site at the X-611 Water Treatment Plant. Further, the deed notation currently filed with Pike County restricts the use of groundwater at the site. Thus, the on-site worker would not use groundwater for drinking or showering so dermal and ingestion exposure scenarios would not apply and therefore PORTS would not be required to meet MCLs (i.e., $1x10^{-6}$ risk level).

Prior to considering an alternative cleanup level that falls within a risk range of $1x10^{-4}$ to $1x10^{-6}$, the regulators require that PORTS must first demonstrate the inability to achieve a risk level of $1x10^{-6}$ within the groundwater plume through failure of implemented BAT and ALARA methods over a reasonable period of time (e.g. five-year remedial action evaluation), despite national performance data indicating that no technologies currently exist that can reduce DNAPLs in source areas within this time period. In addition, implemented remedial actions are required to be evaluated for effectiveness on a five-year timeframe. DOE's position is that the five-year evaluation period may not permit sufficient time for all remedies to demonstrate effectiveness in achieving the cleanup goals established in Decision Documents and could result in a premature determination of whether additional remedial actions are necessary. Further, having the property boundary as the physical point of compliance (rather than the body of the plume) would allow for monitored natural attenuation to occur over time for most plumes (would not apply to the X-749/X-120 Plume due to its proximity to the property boundary) and would preclude the need for a demonstrated technology failure.

The estimated cost to achieve the ES Vision in groundwater is approximately \$225.2M. The estimated cost to achieve the current planned baseline end state is approximately \$372M. The cost to achieve the ES Vision would be approximately \$146.8M less than the cost to achieve the current planned baseline end state. The difference between the estimated costs for both end states is due primarily to the cessation of some remediation activities currently ongoing within the X-701B plume. Under the ES Vision: oxidant injection O&M (\$140.2M) would cease; the five-year remedial action evaluation (\$680K) associated with the oxidant injection would cease; the X-701B cap (\$5.3M) would not be constructed; the X-701B cap O&M (\$340K) would not occur; and replacement of 20 phytoremediation trees per year (\$280K) for the X-740 plume would not occur. This estimate is generally based on the PORTS life-cycle baseline costs (see Appendix A) and is escalated at 4% per year through FY 2034 and includes remediation, post-remediation, surveillance and maintenance, and environmental monitoring.

1. INTRODUCTION

This report presents the End State (ES) Vision (formerly Risk-Based End State or RBES) and Variance Report for the Portsmouth Gaseous Diffusion Plant (PORTS) located near Piketon, Ohio (DOE/OR/11-3137&D2). The ES Vision document was prepared in accordance with the requirements set forth in a memorandum from Jessie Roberson, Department of Energy (DOE) Assistant Secretary for Environmental Management, dated September 22, 2003 (DOE 2003a) that called for development of a risk-based end state vision document and variance report. The information presented in this document is consistent with two attachments to this memorandum including DOE Policy 455.1, entitled *Use of Risk-Based End States* (DOE 2003b), and a standardized approach set forth in a guidance document dated September 11, 2003, entitled *Guidance for Developing a Site-Specific End State Vision* (DOE 2003c). The guidance was further clarified by a memorandum dated December 23, 2003, entitled *Risk Based End State Guidance Clarification* (DOE 2003d) and memorandum dated November 12, 2004, entitled *Final End States Vision Documents* (DOE 2004). DOE Policy 455.1 and subsequent guidance was developed in response to the February 2002 *Top to Bottom Review of the EM Program* (DOE 2002a), which recommended moving DOE's Environmental Management (EM) program to an accelerated, risk-based cleanup strategy and aligning the scope of the EM program to be consistent with an accelerated, risk-based cleanup.

DOE's primary objective of the ES Vision process is to evaluate each site consistently across the entire DOE complex to document the current state as of 2005; the current baseline end state per current regulatory agreements; clearly articulate the ES Vision; and identify variances that may exist between the two end states in a single, unified approach. The goal of this document is to comply with the aforementioned DOE Policy 455.1 requirements and to meet these objectives as they relate to PORTS.

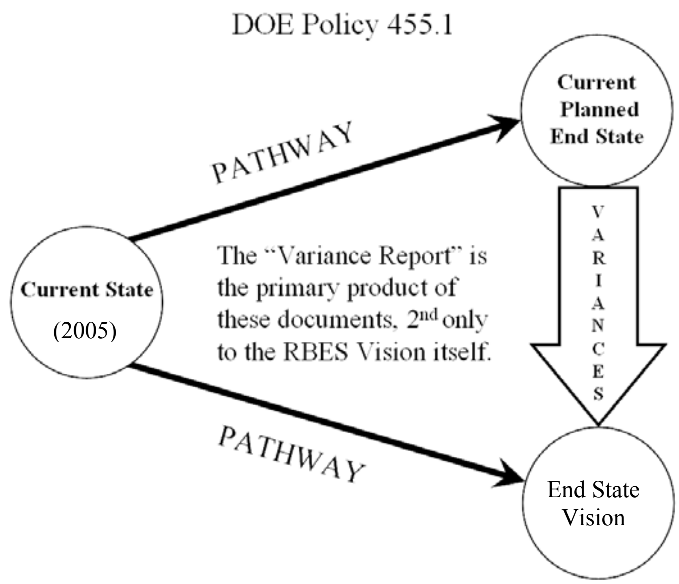

Fig 1.1. Conceptual product diagram for the ES Vision.

The ES Vision document is not a decision document and DOE recognizes that the ES Vision may not agree with existing site compliance agreements and regulations or all stakeholder preferences. It is not the intention of this document to preclude continuing with existing regulatory agreements or to authorize implementation of the variances that may be inconsistent with the existing regulatory agreements, decisions, and/or statutory requirements. Rather, the variances identified in this document become a baseline for evaluation, as appropriate, in future decision documents. In the event DOE chooses to seek changes or approaches stemming from the ES Vision process, it will do so in accordance with all applicable legal requirements.

The ES Vision is driven by the current and expected future land use for areas at and around PORTS and the exposures that may occur to potential receptors in these areas. The exposures considered in developing this ES Vision were derived consistent with the United States Environmental Protection Agency's (EPA) risk assessment guidance documents (e.g., EPA 1989, 1996, and 2000). These exposures, which are depicted in a series of conceptual site models (CSMs) and treatment trains, described in detail in Chap. 4 of this report, are based on realistic scenarios that consider reasonable pathways of exposure and expected potential receptor populations.

Integral to developing the PORTS ES Vision are the stakeholders and interested parties, which include, but are not limited to, DOE, EPA, State of Ohio, United States Enrichment Corporation (USEC), Uranium Disposition Services LLC (UDS), Southern Ohio Diversification Initiative (SODI), Pike County, Village of Piketon, and surrounding residents, as well as the general public. When finalized, this document will serve as the primary communication tool for the PORTS ES Vision with these stakeholders.

A key component to developing this ES Vision document is the use of the PORTS geographic information system (GIS). The GIS integrates multiple sets of geographically referenced data received from various sources at the site, county, state, and federal levels to create maps that follow a standardized hierarchical approach to depict PORTS in a regional, site, and hazard-specific context. These maps are intended to present and allow comparisons between current and future land use; depict hazards and risks to affected or potentially affected receptors; serve as a decision-making tool for site management; enhance communication of risks during discussions with stakeholders; allow tracking of expected and actual cleanup results; and serve as a communication tool for public meetings in regards to cleanup activities, current PORTS missions, and future land use.

- The PORTS ES Vision document depicts a set of site conditions and associated information to establish clearly articulated and technically achievable cleanup goals that will sustainably protect human health and the environment for the planned land use of PORTS and its environs.
- The ES Vision document is intended to enable readers to understand the current state of cleanup progress at PORTS and to understand one or more alternative end states that is sustainable, protective, and accounts for appropriate future land uses.
- The ES Vision document examines future actions based on alternative scenarios associated with land use plans, hazard information, and risk assessments.

The ES Vision document contains two important comparisons. The first comparison is between the current state (as of 2005) and the ES Vision at PORTS. This comparison is used to depict the risk reduction that would be achieved at the ES Vision. The second comparison is between the ES Vision and the current cleanup baseline end state (i.e., the current planned end state that would be achieved upon fully executing the actions contained within the current regulatory agreements, as described in Sect. 1.3) and is used to identify variances between the ES Vision and current planned baseline end state, as depicted in Fig. 1.1.

Although remedies for cleanup are identified in the ES Vision document, this report is not a decision document. As the ES Vision evolves, DOE will further evaluate the cleanup activities and the strategic approaches at PORTS to determine whether it is appropriate to pursue changes to the PORTS baseline. Any decision to pursue changes to the PORTS baseline will include factors beyond those presented in this ES Vision document, such as input from its stakeholders or other interested parties. As stated above, should DOE ultimately decide to seek changes stemming from the ES Vision process, it will do so in accordance with all applicable legal requirements.

The ES Vision and the current baseline end state presented in this document are based upon a 30-year planning period. This report is a living document that will be reviewed, updated, and resubmitted annually, reflecting the continued remediation and public input processes, and any change in the regulatory environment that occurred throughout the preceding year. As such, DOE will continue to work with its stakeholders as the ES Vision evolves to ensure there is continuing opportunity for public and stakeholder participation and input on the evaluation and potential implementation of concepts and/or ideas derived from the ES Vision process.

1.1 REPORT ORGANIZATION

This ES Vision document is presented in six chapters. Chapter 1 presents general background information including the purpose and organization of this document; a summary of the current PORTS mission; a discussion of the status of the PORTS cleanup program, which includes a description of the regulatory agreements that currently drive the baseline cleanup effort; and a discussion that clearly presents the PORTS ES Vision. Chapter 2 discusses and depicts the current state and ES Vision in a regional context to portray PORTS within its larger contiguous regional area and characterize its relationship to possible off-site pathways and human or ecological receptors of concern. Chapter 3 discusses and depicts the current state and ES Vision in a site context that describes and presents information similar to that provided in Chap. 2, but at a greater level of detail specific to the immediate PORTS area. Chapter 4 provides a discussion of PORTS in a hazard-specific context, which provides the greatest detail and presents the PORTS current state, ES Vision, and the PORTS current baseline end state per current regulatory agreements. Chapter 4 also depicts the hazard areas (e.g., landfills, groundwater plumes, and legacy waste) at PORTS that are sources of actual and potential hazards to human health and the environment. The hazard-specific context maps associated with Chap. 4 are presented in conjunction with a series of CSMs for PORTS that depict how receptors currently are, or may be exposed to contamination depending on whether the ES Vision or the current baseline end state is attained. In addition, Treatment Trains are provided to present the expected treatment of each hazard under the ES Vision and current baseline end state and to indicate which receptors might be exposed as a result of the treatment presented. Chapter 4 also discusses potential barrier failure and provides a qualitative probability of barrier failure and consequence. Chapter 5 presents the ES Variance Report that identifies and discusses differences between the current PORTS baseline end state per existing regulatory agreements and the ES Vision; identifies and describes the impacts of the variances in terms of scope, cost, schedule, and risk; identifies and describes the barriers in achieving the ES; and provides recommendations for overcoming the barriers to achieve the ES. Chapter 6 provides a comprehensive list of references used to prepare this document and separates them into those used within the text and those used to complete the figures. In addition to these chapters, two appendices are provided. The first appendix (Appendix A) includes DOE’s life-cycle baseline cost breakdown for PORTS. The second appendix (Appendix B) chronicles information regarding stakeholder involvement, including all written comments received, announcements and news paper clippings, and attendance sheets from each public meeting and workshop.

In conjunction with the discussions provided in Chaps. 2 through 4, a series of maps is included that follow a standardized hierarchical approach to depict PORTS in a regional, site, and hazard-specific context to graphically convey the relationship between PORTS and its environs. As described above, these maps are intended to present and allow comparisons between current and future land use; depict hazards and risks to affected or potentially affected receptors; serve as a decision-making tool for site management; enhance communication of risks during discussions with stakeholders; allow tracking of expected and actual cleanup results; and serve as a communication tool for public meetings in regard to cleanup activities, current PORTS missions, and future land use. Multiple sets of geographically referenced data were collected and integrated from various sources at the site, county, state, and federal levels to create these maps.

1.2 PORTS SITE MISSION

The information presented in this section was derived directly from the PORTS Program Management Plan (PMP) (DOE 2003e). DOE's near-term mission at PORTS is focused on three major activities: maintenance of the Gaseous Diffusion Plant (GDP) in cold standby status; environmental management of the site and other facilities; and construction of a Depleted Uranium Hexafluoride (DUF_6) Conversion Facility. These activities are managed by DOE's three prime contractors at PORTS: USEC, Bechtel Jacobs Company, LLC (BJC), and UDS. It should be noted that, while not an official DOE mission as prescribed by the PMP, commercial uranium enrichment should be considered a site mission at PORTS. This is due to: 1) USEC's 2002 announcement of the American Centrifuge Demonstration Facility that will be constructed and implemented by 2005, which will contain a lead cascade of up to 240 centrifuge machines; and 2) USEC's January 2004 announcement of a full deployment of the American Centrifuge Uranium Enrichment Plant to be located at PORTS. Current missions are those considered near-term from the present until fiscal year (FY) 2006 (DOE 2003e).

- **Cold Standby –** The Cold Standby Program is designed to maintain the GDP facilities in a condition that would allow restarting uranium enrichment operations within 18-24 months. DOE has determined that this status will provide acceptable future enrichment capabilities for national security or commercial purposes in the U.S. if existing or planned facilities cannot meet the country's needs. Cold standby is currently scheduled to end in 2006.

- **Environmental Management –** A critical DOE mission is the planning, implementation and completion of environmental management actions at operating and inactive DOE facilities. The DOE/PORTS EM Program is designed to protect human health and the environment from risks posed by inactive facilities, surplus facilities, and contaminated areas by remediating sites and facilities in the most cost-efficient and responsible manner possible by 1) reducing the "mortgage" costs associated with surveillance and maintenance of large volumes of stored legacy waste, maintenance of very large industrial buildings, and protecting workers from contamination within those buildings; 2) protecting the public from potential exposure to radioactive and hazardous materials; and 3) meeting regulatory requirements.

- **DUF_6 Conversion Facility –** Construction and operation of this facility is necessary to eliminate hazards and costs associated with continued storage of DUF_6 in cylinders stored at PORTS and in Oak Ridge, Tennessee.

Funding for these near-term missions is allocated in accordance with Project Baseline Summaries (PBSs) that fall under Budget and Reporting Classifications (B&Rs). These B&R classifications are congressional level control points for activities and programs at DOE/PORTS and other sites. The PBSs are further broken down into work breakdown structures that are used for formulation and execution of the budget; the reporting of actual obligations, costs, and revenues; and the controlling and measuring of actual versus budgeted performance. Most PORTS scope is funded under three B&R classifications:

- **Decontamination and Decommission (D&D) Fund;**
- **Other Uranium Program Maintenance Fund; and**
- **Safeguards & Security Fund.**

The Office of Management and Budget apportions Congress-approved B&R funds into a Project Baseline Summary (PBS) structure. The appropriation language is specific in terms of the scope to be funded under each of the different B&R sources. DOE Headquarters then allocates the apportioned funds to DOE Field and Project Offices. The three B&R classifications used at PORTS are allocated in eight PBS definitions associated with each near-term mission described below:

- **D&D Fund**
  - **Nuclear Facility D&D**

Remedial action, surveillance and maintenance, and D&D activities at PORTS are necessary due to contamination resulting from the plant's previous uranium enrichment operations. Groundwater, sediment, and soil contamination exist at the site. Contaminants of concern include radioactive technetium-99, polychlorinated biphenyls (PCBs), trichloroethene (TCE), and Resource Conservation and Recovery Act (RCRA) heavy metals.

In 1980, DOE submitted a notification of hazardous waste activity at PORTS. In September 1989, DOE and the EPA entered into an Administrative Consent Order, and in August 1989 DOE entered into a Consent Decree with the State of Ohio. The Consent Order/Consent Decree contain the following mutual objectives:

- Perform integrated RCRA/CERCLA facility/remedial investigations (RFI/RI) to determine the nature and extent of any hazardous materials previously released at or from the site.

- Perform interim remedial measures, if necessary, to prevent future releases of hazardous waste, constituents, or substances from the site.

- Perform integrated corrective measures/feasibility studies (CMS/FS) to identify and evaluate alternatives for mitigation of the effects of hazardous material releases on human health and the environment.

- Conduct corrective/remedial actions that are deemed necessary by the regulators to protect human health or the environment and achieve compliance with applicable requirements.

- Prepare and implement work plans for the above referenced documents in an expeditious manner.

In accordance with these agreements (see Sect. 1.3), PORTS has been divided into four quadrants that roughly correspond to a distinct groundwater flow cell within the primary water-bearing unit beneath the site. Because the flow cells are the major pathways for contaminant migration, each has been investigated separately.

There were 104 RCRA Corrective Actions Program Solid Waste Management Units (SWMU) requiring characterization and possible remediation. There are several regulated land disposal units being addressed under State of Ohio RCRA Closure and Solid Waste programs. Since cleanup activities began, all initial assessments required under the cleanup agreements have been completed, containment activities/remedial measures have been taken on all groundwater plumes, and approximately 25 hazardous and solid waste units have been closed and/or remediated.

During the fourth quarter of 1997 and the first quarter of 1998, the U.S. Department of Energy (DOE), the U. S. Environmental Protection Agency (U.S. EPA), and the Ohio Environmental Protection Agency (Ohio EPA) held a series of Decision Team meetings to establish the strategy for remediation of the Portsmouth Gaseous Diffusion Plant (PORTS) site. During these meetings, the Decision Team agreed that each unit at PORTS would be identified, evaluated, and categorized into one of three groups. The groups included units that require: (1) no further action; (2) deferral to deactivation and decommissioning (D&D); and (3) remediation or action.

The remediation of some units has been deferred until D&D of the site. By the end of FY 2006, assessments and corrective/remedial actions will have been constructed, installed, and in operation for all non-deferred units except X-701B groundwater and soils. Corrective actions for X-701B groundwater and soils will continue through FY 2008. DOE will continue to operate active and passive groundwater treatment systems, installed as part of the corrective action referenced above, until regulatory-directed cleanup levels are achieved. Surveillance and maintenance of remedial action sites will continue beyond FY 2006.

Tasks associated with the PORTS environmental monitoring program will continue to monitor environmental conditions and the effectiveness of chosen remedial actions. The continuing presence of USEC's cold standby activities and advanced centrifuge technology deployment has delayed the decision on eventual D&D of the GDP and the related deferred units.

— **Solid Waste Stabilization and Disposition**
This PBS involves storage, characterization, treatment, and disposal of legacy waste generated by activities at the Portsmouth GDP prior to 1993. The primary waste steams are low-level, mixed low-level, Toxic Substance Control Act (TSCA)-low level, hazardous, and sanitary wastes. The life-cycle estimate for the low-level and mixed low-level wastes to be addressed is approximately 43,000 cubic yards (yd^3). Prior to FY 2003, approximately 17,000 yd^3 had been dispositioned. DOE plans to disposition all of remaining legacy wastes by the end of FY 2007. The waste streams have been ranked for treatment and disposal using a risk-based prioritization system.

This PBS also includes pollution prevention projects to reduce the generation, volume, toxicity and release of multi-media waste, to promote the use of non-hazardous materials, and achieve operating efficiency through the application of pollution prevention principles.

— **Portsmouth Contract/Post Closure Liabilities**
The scope of this PBS involves ongoing litigation expenses and record searches in support of litigation. These are ongoing level-of-effort tasks that require annual funding. The litigation funding supports any legal cases filed by plaintiffs alleging damages from or relating to PORTS. The record search task provides support to the legal effort. The task also involves record searches for DOE and Department of Justice investigations/studies, Freedom of Information Act requests, and requests from state and federal regulatory agency staff and elected officials. These activities are likely to continue.

- **Other Uranium Program Maintenance Fund**

— **NM Stabilization and Disposition – PORTS Cylinder Management**
This PBS provides management of the Highly Enriched Uranium (HEU) Program, surveillance and maintenance of the former Uranium Program facilities, management of approximately 19,000 uranium hexafluoride (UF_6) cylinders, and management of legacy (PCB) contamination.

The HEU Program activities will continue until a decision is made to place the HEU process building (Building X-326) into the D&D program, currently estimated to be after 2010. The HEU Program stores, ships, treats, and disposes of filter and incinerator ashes; disposes of the remaining HEU materials (i.e., oils, acids and alumina) stored in the X-326 L-Cage; provides interim storage of HEU materials at the Nuclear Fuel Service (NFS) facility in Tennessee; performs engineering design, special equipment procurement, construction, and safety/regulatory reviews of small-scale highly enriched uranium hexafluoride for the oxide conversion facility at NFS; performs surveillance and maintenance on the 158 permanently shut down cells in Building X-326; and operates the Enriched Uranium-DOE Materials Storage Area-12.

Surveillance and maintenance of the former Uranium Program facilities includes surveillance and maintenance of DOE-leased and non-leased facilities (i.e., two cylinder yards). Inventories of special nuclear materials and technical support to cold standby activities are also performed. Management of the 19,000 DUF_6 cylinders will continue until turnover to the DUF_6 conversion facility operator UDS occurs.

The project for management of legacy PCB contamination includes activities related to maintaining compliance with TSCA, the Uranium Enrichment Toxic Substances Control Act Federal Facilities Compliance Agreement of 1992, DOE orders, and other applicable requirements. PCB activities include inspections of transformers, checks of spill sites, inspection, repair and maintenance of troughs and collection systems, cleanup of spills, sampling and analysis of spills and equipment, and compliance reporting.

The compliance measures for the Uranium Enrichment Toxic Substances Control Act Federal Facilities Compliance Agreement of 1992 have varied completion dates. The measures having the latest completion dates are the removal of gaskets, ducts, and hydraulics systems, which must be complete by 10 years after the date of facility D&D. Periodic PCB air sampling in the process buildings must continue until one year after the facility is shut down.

— **NM Stabilization and Disposition – DUF_6 Conversion**
Approximately 700,000 metric tons of DUF_6 are stored in 60,000 cylinders at the Paducah and Portsmouth GDP sites and at the East Tennessee Technology Park (ETTP) in Oak Ridge. This PBS scope involves designing, permitting, building, and operating a DUF_6 conversion facility at the Portsmouth GDP. The facility will convert DUF_6 into a more stable form, a depleted uranium oxide suitable for reuse or disposition. The uranium oxide is expected to be disposed at Envirocare or Nevada Test Site. Hydrogen fluoride is planned to be sold on the commercial market, and the empty cylinders will be disposed or reused.

The PBS scope includes transport of approximately 6,000 cylinders from ETTP to PORTS for conversion. This PBS also includes surveillance and maintenance of all cylinders during conversion of the existing stockpile, which should take approximately 18 years. The DUF_6 facility operator will assume responsibility for maintenance and surveillance of all DUF_6 cylinders.

— **Nuclear Facility D&D – PORTS Gaseous Centrifuge Enrichment Plant (GCEP)**
This PBS involves accelerated cleanup of the GCEP facilities at Portsmouth for use by USEC in the development of an advanced uranium enrichment process. On December 4, 2002, USEC announced that it would construct its demonstration centrifuge uranium enrichment test facility at the Portsmouth site. This announcement followed a June 17, 2002, agreement between DOE and USEC in which USEC will deploy an advanced centrifuge uranium enrichment plant by 2010-2011. PORTS was selected in December 2002 as the location for the American Centrifuge Demonstration Facility and it was announced in January 2004 that PORTS will be the location for full deployment of the American Centrifuge Uranium Enrichment Plant. Part of this commitment involves cleanup of the GCEP facilities at Portsmouth.

— **PORTS Cold Standby**
On March 1, 2001, DOE decided to place PORTS in cold standby after USEC's decision to cease production of enriched uranium at the plant. This PBS scope involves maintaining the

inactive GDP equipment in cold standby so that operations can be restarted within 18-24 months, if necessary. Activities include purging the cascade process equipment of uranium hexafluoride, buffering with dry air, maintaining the Freon inventory, removal of uranium deposits from systems and equipment, and heating several buildings on the site to prevent damage from freezing in winter.

In FY 2004, DOE will continue to have USEC operate the shipping and transfer facilities to remove technetium-99 from the contaminated uranium feed inventory. It is expected that PORTS will be taken out of the cold standby state and transitioned to D&D pending the successful development of new technology for enriching uranium. The current plan is for USEC to have an American Centrifuge Uranium Enrichment Plant built and ready to operate by 2009-2010.

- **Safeguards and Security**
  - — **PORTS Safeguards and Security**
    This PBS provides an integrated Safeguards and Security Program which includes the following program elements: Physical Protection Protective Forces; Physical Security Systems; Information Security; Personnel Security; Material Control and Accountability; Program Management; and Cyber Security.

Other funding types at PORTS include Technology Development, Transparency Measures, Worker Transition, University Material Retrieval, and Work for Others. Funding from these sources is usually small, and the life-cycle baseline duration of the activities is uncertain.

- **PORTS Long-Term Surveillance**
  - — This PBS provides long-term stewardship for the remediated sites at PORTS for as long as residual contamination poses a risk to the public or the environment. Over the past 50 years, the production activities carried out at PORTS have resulted in several contaminated sites and facilities. In recognition of its responsibility for these environmental problems, DOE has committed to remediate contaminated sites and facilities, and to dispose of stored legacy waste. Long-term stewardship activities are intended to prevent receptors (people, plants and animals) from encountering the residual hazard through land use controls and to prevent the residual hazard from migrating to receptors through engineering technologies.

- **Overhead Items and Work for Others**
  - — Funding for certain activities at PORTS is not linked to a specific PORTS PBS. These activities are designated as Overhead Items or Work for Others.
  - — **Overhead Items**: DOE (through its contractors) is responsible for maintenance of roads, portals (vehicular and pedestrian), security fencing, most of the grounds on the exterior of Perimeter Road, and approximately 60% of the grounds inside Perimeter Road (those areas not in the immediate vicinity of the leased GDP facilities). These and other activities are considered overhead items. The cost for overhead items is spread over all of the PORTS PBSs.
  - — **Work for Others**: DOE/PORTS also receives funding for PORTS activities designated as Work for Others. The funding sources may be from other DOE sites or from outside agencies. Examples of Work for Others include maintenance of on-site facilities leased by DOE to the Ohio Army National Guard, HEU transparency, and the Uranium Management Group Activities.

    HEU transparency is a program developed by the State Department based on an agreement with the Russian Federation on the destruction of nuclear warheads and the reutilization of the nuclear material for peaceful, commercial uses. It is administered by the Safeguards and Security group of the EM Contractor and USEC, and funded through the FS-30 B&R classification. Plans and procedures for administering this program are maintained by USEC as the Executive Agent.

In June 1998, DOE initiated the consolidation of potentially reusable uranium materials from various DOE and other sites. In FY 1999, DOE undertook an initiative to provide interim storage for surplus uranium materials at PORTS until the materials could be permanently stored, disposed, reused, or sold. In FY 1999, DOE/Oak Ridge created the Uranium Management Group to provide a coordinated, cost-effective, and efficient program for management of surplus uranium resources.

The interim storage facility is used to temporarily store commercially marketable solid uranium in several forms and enrichments. Approximately 4,500 metric tons of normal uranium, depleted uranium, and low enriched materials from the Fernald site near Cincinnati have been placed in interim storage at PORTS. About 1,700 metric tons of low enriched uranium have been shipped for interim storage at the site from the DOE's Hanford Reservation in Richland, Washington. In addition, another 25,700 pounds of uranium materials that had been loaned to five universities for research has been returned to DOE and is stored at Portsmouth.

1.3 STATUS OF PORTS CLEANUP PROGRAM

The following discussion provides a summary of the current status of the cleanup program at PORTS and includes: a summary of the regulatory agreements currently in place that form the basis for the PORTS baseline cleanup end state; a brief discussion of cleanup activities that have occurred at PORTS; and a discussion of units that have been deferred for further evaluation until D&D activities.

1.3.1 Summary of PORTS Current Regulatory Agreements

Environmental restoration and waste management activities at PORTS are governed by the following regulatory documents:

- Consent Decree of August 31, 1989 from the Ohio EPA (Ohio EPA 1989). This RCRA driven agreement requires DOE to complete site investigations to determine the nature and extent of any contamination that exists at PORTS, complete cleanup alternative studies, and implement corrective actions as needed;

- Administrative Consent Order of August 11, 1997 from the US EPA (EPA 1997). This is the federal equivalent to the Ohio EPA Consent Decree discussed above;

- Director's Final Findings and Orders of March 17, 1999 from the Ohio EPA (Ohio EPA 1999). These orders were issued by the Ohio EPA Director for the integration of five RCRA hazardous waste closures into the RCRA corrective action process. It also allows for integration of the groundwater monitoring and surveillance and maintenance programs associated with units that had been closed under RCRA and Solid Waste rules;

- RCRA Part B Permit, which incorporates the Consent Decree and the 1999 DFFO (Ohio EPA 2001). This is a RCRA permit that governs storage of hazardous waste in specified areas in the X-7725 and X-326 Buildings;

- Director's Final Findings and Orders of October 1995 (Ohio EPA 1995). These orders were issued by the Ohio EPA for the storage of mixed (hazardous and radiological) wastes beyond one year;

- Director's Final Findings and Orders of February 1998 (Ohio EPA 1998a). These orders were issued by the Ohio EPA for the management of DUF_6 cylinders and lithium hydroxide stored at PORTS; and

- Director's Final Findings and Orders of March 2004 (Ohio EPA 2004). These orders were issued by the Ohio EPA Director for the shipment and management of DOE compliant DUF_6 cylinders being shipped from Oak Ridge, TN to PORTS.

1.3.2 Completed and Ongoing Cleanup Actions

PORTS has conducted several cleanup actions throughout the site since the early 1990s. The following provides a brief summary of various actions that have occurred or are ongoing during this timeframe:

- March 1991: *Well 6B Remediation at the X-608B Well Field*. Well 6B was installed in 1975 as part of PORTS' X-608B well field located on the Scioto River near Piketon. On March 1, 1989, it was discovered that the oil reservoir had disconnected from the pump body resulting in the release of eight gallons of mineral oil and some elemental mercury. The well was remediated through a series of actions including oil removal, caustic solution application, and aggressive cleaning. The well casing and screen was also replaced.

- June 1991: *X-616 Liquid Effluent Treatment Facility and Surface Impoundments Closure*. Chromium contaminated sludge was removed from two lagoons at X-616 and replaced with clean soil, leaving in its place a grassy field. The sludge was placed in two Ohio EPA-approved monocells that were specifically designed to receive sludge within the PORTS sanitary landfill.

- November 1991: *X-701B Holding Pond*. The X-701B Holding Pond, located in the northeastern portion of the plant, consists of a holding pond and two sludge containment ponds. The site historically received liquid wastes from various plant operations from 1954 to 1988. One foot of material was excavated from the bottom and sides of the X-701B Holding Pond. After drying, the material was placed into containers and eventually disposed of as mixed hazardous waste. A groundwater collection system and treatment facility was also constructed to capture and treat solvent-contaminated groundwater at X-701B.

- May 1992: *X-231B Oil Biodegradation Plots Soil Mixing and Capping Project*. Two plots totaling 36,000 square feet were historically used to bio-treat waste oils. A thermally enhanced vapor extraction technology demonstration was successfully performed where a large auger mixed contaminated soil and injected hot air and steam. Vapors were collected in a shroud covering the treatment area. More than 90% of the VOCs were removed from the demonstration area over a four-hour period.

- December 1992: *X-749 Contaminated Materials Disposal Facility*. A multilayer clay cap was installed on an 11.5 acre low-level radioactive waste landfill. The landfill was then closed under RCRA.

- June 1993: *X-744G Hazardous Waste/Bulk Storage Facility*. The X-744G Hazardous Waste/ Bulk Storage Facility was an 88,000 square foot warehouse constructed in 1956. The facility was split into two distinct storage areas for the purpose of housing classified and unclassified wastes. All wastes were relocated and the facilities decontaminated. Certification of RCRA closure was received from the Ohio EPA.

- September 1993: *X-700 Chemical Cleaning Facility Tanks – Chromic Acid Tanks 6, 7, and 8*. The X-700 Chemical Cleaning Facility was used since 1955 for the cleaning and maintenance of non-radioactive or low-radioactively contaminated equipment and parts. Tanks 6 and 8 contained unfiltered wastewater from the basement sump that was contaminated with trichloroethane (TCA) and trichloroethylene (TCE). Tank 7, known to contain chromic acid cleaning solution, was closed in late 1993. Closure of Tanks 6 and 8 soon followed.

- September 1993: *X-752 Waste Storage Facility Closure*. Constructed in 1978, the X-752 Hazardous Waste Storage Unit consisted of a concrete floor with a metal roof and metal walls. Measuring 300 feet by 50 feet, the facility was used for storage of hazardous waste. The facility underwent decontamination and RCRA closure.

- April 1994: *X-749A Classified Materials Disposal Facility Closure*. The X-749A Classified Materials Disposal Facility was used for the historical disposal of several waste streams, including classified wastes. A two-phase closure approach was employed. The first phase was the installation of a drainage system on the west side of the landfill to collect surface water run-off. The second phase was the construction of a multilayer soil cap over the six-acre classified materials landfill.

- September 1994: *X-749 Contaminated Materials Disposal Facility*. A 1,077 foot subsurface clay mortar (slurry) diversion wall was constructed as an interim action to prevent solvent-contaminated groundwater from moving beyond the DOE property boundary.

- November 1994: X-749B *Peter Kiewit Landfill Closure Phase I*. The X-749B Peter Kiewit Landfill, named after the original construction contractor of the plant, was historically used as a salvage yard, a burial facility for construction waste, and later as a sanitary landfill. A two-phased closure approach was developed. Phase I was completed in 1994 that included the installation of a drainage system along the west side of the landfill to collect surface runoff. Phase II occurred in 1998.

- July 1995: *X-735 RCRA Landfill Closure*. The X-735 Landfill area contains two main units: the hazardous waste landfill at the northern portion and the X-735 Industrial Solid Waste Landfill at the southern portion. Closure activities were completed over the northern portion that included the construction of a multi-layer RCRA Subtitle C clay cap. Closure of the southern portion occurred in 1998.

- July 1995: *X-744Y Mixed Waste Storage Yard Cleanup*. The X-744Y Waste Storage Yard covers approximately 15 acres and surrounds the X-744G Hazardous Waste/Bulk Storage Building. The yard was a general purpose storage area. It was determined that mixed solid waste rags were stored inside some of the containers. A sorting project ensued to segregate the mixed waste rags.

- November 1995 to 2003: *X-749/X-120 Groundwater Plume*. A passive treatment facility (X-625) was constructed that uses a process of reactive media to break down VOCs into non-hazardous components. No outside energy was necessary to power the treatment facility. The treatment facility became fully operational in February 1996 and was placed in standby in 2003.

- May 1996: *X-705A/B Incinerator Demolition*. The X-705A/B Incinerator historically burned uranium-contaminated waste, such as protective clothing. A three-phase decontamination and decommission (D&D) process began in August 1995. The first two phases – preparing the facility for demolition and actual facility demolition – were completed in May 1996. The third phase – soil cleanup – is pending full-scale plant D&D.

- July 1996: *X-231A Oil Biodegradation Plot Hydraulic Fracturing Technology Demonstration and Capping*. The X-231A Oil Biodegradation Plot, located in the central portion of the plant site, was used to dispose liquid wastes between 1971 and 1976. A demonstration using hydraulic fracturing to implement different in-situ remediation technologies was performed.

- September 1996: *X-611A Lime Sludge Lagoons Prairie Ecosystems*. Three lime sludge lagoons located northeast of the main plant were historically used to hold waste lime from the X-611 Treatment Plant. The lagoons were dewatered (some 85 million gallons), 100,000 ft^2 of geotextile liner were placed, and 12,000 truckloads of soil dumped over the liner to create the prairie ecosystem. The system was finished by seeding it with 38 varieties of prairie grasses and wild flowers.

- December 1996: *X-701B Holding Pond*. The X-701B Holding Pond, located in the northeastern portion of the plant, consists of a holding pond and two sludge containment ponds. The site historically received liquid wastes from various plant operations from 1954 to 1988. Two horizontal wells were installed as a technology demonstration that coupled a recirculation well network with in-situ treatment modules to remove TCE and radionuclides.

- September 1997: *X-705A/B Soil Removal Action*. The X-705A/B Incinerator historically burned uranium-contaminated waste, such as protective clothing. A liner was placed over contaminated soil, clean soil was placed over the liner and seeded. The interim measure is a stop-gap pending final D&D of the plant.

- September 1998: *X-749B Peter Kiewit Landfill Closure Phase II*. The X-749B Peter Kiewit Landfill, named after the original construction contractor of the plant, was historically used as a salvage yard, a burial facility for construction waste, and later as a sanitary landfill. A two-phased closure approach was developed. The second phase was the construction of a multi-layered cap and included the relocation of Big Run Creek approximately 1,000 ft to the east. Construction also included installing a seep collection system on the east side of the landfill. Phase I occurred in 1994.

- September 1998: *X-735 RCRA Sanitary Closure*. The X-735 Landfill area contains two main units: the hazardous waste landfill at the northern portion and the X-735 Industrial Solid Waste Landfill at the southern portion. Closure activities were completed over the southern portion that included the constructed of a RCRA Subtitle D cap. Closure of the northern portion occurred in 1995.

- November 1998: *X-720 Neutralization Pit Removal*. A concrete pit measuring 8.5 ft long by 6 ft wide by 8 ft deep was located outside the X-720 Maintenance Building. The purpose of the pit was to neutralize acidic cleaning fluids used within the facility. A majority of the pit was removed with the remainder grouted in-place.

- December 1998: *Pilot Treatment Projects Program*. The DOE Portsmouth Gaseous Diffusion Plant Technology Applications Program was started to evaluate innovative or experimental environmental technologies and their potential for use at the plant. Under the program, a vacuum enhanced recovery (VER) method was used to extract VOCs from groundwater at the X-701B plume.

- May 1999 and ongoing: *X-740 Waste Oil Handling Facility/Groundwater Phytoremediation*. The X-740 Waste Oil Handling Facility consists of two hazardous waste management units: the X-740

Waste Storage Facility and the X-740 Hazardous Waste Storage Tank. A phytoremediation plot was planted consisting of 765 hybrid Poplar trees over a 2.6 acre within the groundwater plume.

- July 1999: *X-701B Holding Pond*. The X-701B Holding Pond, located in the northeastern portion of the plant, consists of a holding pond and two sludge containment ponds. The site historically received liquid wastes from various plant operations from 1954 to 1988. Dynamic underground steam stripping and hydrous pyrolysis oxidation was applied to the site as a pilot project. Approximately 7.5 million pounds of steam was injected into wells near the former holding pond. The process vaporized the VOC contaminants and forced them into centrally-located extraction wells.

- September 1999: *X-734A/B Construction Spoils Landfill Closure*. The 16.2 acre X-734 Landfill served as a sanitary waste and construction debris disposal site from 1968 to 1991. A two-phased closure approach was adopted. The first phase was completed in September 1999 and covered the 4.6 acre southern portion with a 16-inch compacted soil cap. The second phase was completed in September 2000 that included capping the northern portion.

- September 2000 and ongoing: *Legacy Waste Management*. Limited disposal facilities resulted in the accumulation of quantities of waste. The site developed programs and procedures that ultimately led to PORTS shipping waste to the Envirocare disposal facility in Utah and receiving certification to ship classified waste to the Nevada Test Site.

- May 2001 and ongoing: *X-701A/C*. The X701A/C consists of two facilities: the X-701A Lime House and the X-701C Neutralization Pit. The lime house was demolished in May 2001. The neutralization pit was also removed in May 2001 by excavation. In addition to the soil removal, hydrogen peroxide was applied to the area to reduce organic contamination. The area was re-graded and seeded.

- May 2001 and ongoing: *X-747H Contaminated Scrap Metal Yard*. The X-747H was a seven-acre area that was used to accumulate radioactive-contaminated scrap metal. To date, 7,100 tons of radioactively-contaminated scrap material have been size reduced, containerized, and shipped off site to Envirocare of Utah and/or Nevada Test Site.

- September 2002: *X-744 Lithium Warehouses*. Large quantities of lithium hydroxide were stored in seven on-site warehouses. 187,000 drums of lithium hydroxide were sold for commercial use and removed from the site.

- Fall 2002 and ongoing: *Five-Unit Investigative Area Groundwater Remediation*. Groundwater investigation focused on groundwater concerns in the northern portion of Quadrant I that identified five solid waste management units as sources to contamination in this area. Eleven new extraction wells were installed and the X-622 groundwater treatment facility was upgraded in 2003 to enhance treatment of the 5-Unit plume.

- May 2003: *X-749 Contaminated Materials Disposal Facility*. The X-749 Contaminated Materials Disposal Facility covers approximately 7.5 acres at the south-central section of the plant. A 1,457 ft barrier wall was constructed around the facility to impede migration of contamination from the landfill.

- July 2003: *X-749/X-120 Groundwater Plume*. The largest phytoremediation project at PORTS was completed that included planting approximately 2,700 hybrid Poplar trees in parallel rows to treat solvent-contaminated groundwater.

- April 2004: *Bioremediation of X-749/X-120 Groundwater Plume.* The goal of this project is to create an in-situ natural dechlorination barrier/remediation zone through which contaminated groundwater must pass before reaching the property boundary. This is accomplished by injecting Hydrogen Release Compound (HRC™) directly into the contaminated plume using direct push technology and a special injection pump. Upon contact with the groundwater, HRC™ releases lactic acid and hydrogen. This increase in hydrogen stimulates the growth of indigenous anaerobic microbes and increases reductive dechlorination of the chlorinated solvent within the groundwater. In this natural process, anaerobic microbes substitute hydrogen for chlorine on chlorinated contaminant molecules, thereby dechlorinating the compound. HRC™ increases the rate of dechlorination by several orders of magnitude, rapidly taking contaminants through a stepwise dechlorination process that ultimately result in non-toxic compounds, such as ethene or ethane. Since HRC™ is formulated to release the lactic acid slowly, the dechlorination process may continue at an accelerated rate from 18 months to 36 months.

- 2004: *X-701B Holding Pond*. The X-701B Holding Pond, located in the northeastern portion of the plant, consists of a holding pond and two sludge containment basins. The site historically received liquid wastes from various plant operations from 1954 to 1988. Several technology demonstrations have occurred to address plume contaminants in this area by injecting oxidant into the groundwater. A Decision Document was issued by Ohio EPA in December 2003 for oxidant treatment of groundwater and capping of the pond and basins. Design work began in 2004.

Ongoing and future remediation activities are discussed in Chap. 4 within each hazard area discussion. The following provides a list of the completed and ongoing cleanup actions at PORTS by quadrant.

<u>Quadrant I Actions</u>

- X-231B Biodegradation Plot IRM
- X-231B Biodegradation Plot Closure
- X-231B Biodegradation Plot CMI
- X-749 North Contaminated Landfill Closure
- X-749 South Contaminated Landfill Closure
- X-749 South Barrier Wall IRM
- X-749 CMI (Bio-phytoremediation)
- 5- Unit Groundwater Plume Pump and Treat CMI
- X-750 Waste Oil Tank Removal
- Peter Kiewit Landfill cap
- Relocation of Big Run Creek at the Peter Kiewit Landfill
- X-622 Groundwater Pump and Treat Facility
- X-625 Groundwater Pump and Treat Facility

<u>Quadrant II Actions</u>

- X-700 Chromic Acid Tanks 6, 7, & 8 Closure
- X-701B Holding Ponds Closure
- X-701B Interceptor Trench IRM
- X-701C Neutralization Pit Closure
- X-705A Incinerator Closure

- X-705 Soils Removal Action
- X-720 Neutralization Pit Removal
- X-744U Storage Facility Closure
- X-744R Storage Facility Closure
- X-744Y Radiological Storage Yard Closure
- X-622T Groundwater Pump and Treat Facility
- X-623 Groundwater Pump and Treat Facility
- X-624 Groundwater Pump and Treat Facility

Quadrant III Actions

- X-616 Surface Impoundment Closure
- X-740 Hazardous Waste Storage Building and Tank Closure
- X-740 Phytoremediation CMI

Quadrant IV Actions

- X-344A Settling Tank Closure
- X-344D Neutralization Pit Removal
- X-734 Landfill Cap
- X-735 Landfill Monocell Closure
- X-735 North Hazardous Waste Landfill Closure
- X-735 South Industrial Solid Waste Landfill Closure
- X-747G Precious Metal Storage Yard Closure
- X-747H Scrap Metal Yard Clean-up (On-Going)
- X-752 Hazardous Waste Storage Facility Closure
- X-611A Lime Sludge Lagoon Clean-up

During the fourth quarter of 1997 and the first quarter of 1998, DOE, U.S. EPA, and the Ohio EPA held a series of Decision Team meetings to establish the strategy for remediation at PORTS. During these meetings, the Decision Team agreed that each unit at PORTS would be identified, evaluated, and categorized. Data collected from soil, groundwater, and surface water in the vicinity of each unit sampled during the RFIs, background studies, groundwater modeling, and risk assessments were all utilized to determine the need for, and relative timing of, remediation. Based on these studies and findings, the PORTS Decision Team categorized each SWMU into one of three groups. The groups included units that require: (1) no further action; (2) deferral to D&D; and (3) remediation or action (DOE 2003h). Deferred and no further action units were established by reviewing RFI data for each of the identified release sites at PORTS and agreements on the status of each unit within the RCRA Corrective Action Program. Selection of units to be deferred to D&D was generally based upon four criteria that were mutually developed and approved by all Decision Team members. A SWMU did not necessarily have to meet all four criteria to be deferred. The four criteria are:

- Under current conditions, the unit being considered for deferral was to have a media-specific, total non-carcinogenic cancer risk with a Hazard Index (HI) generally less than 1 and an Excess Lifetime Cancer Risk (ELCR) range generally between $1x10^{-4}$ to $1x10^{-6}$ (industrial risk scenario);

- Contamination responsible for the risk concern is not mobile;

- Under current use scenarios, on-site worker health and safety programs and routine monitoring are protective of human health and the environment; and

- The physical locations of the units are in or adjacent to current production and operational areas where remedial activities may interrupt operations. Also, such areas would likely become re-contaminated from ongoing production of enriched uranium.

In general, most of the deferred units have been evaluated adequately to demonstrate that no further remediation would be necessary under the ES Vision, as most of these units have already been determined to meet the 1×10^{-4} to 1×10^{-6} risk range and an HI of less than 1. For those units that do not currently meet the 1×10^{-4} to 1×10^{-6} risk range criteria (see Chap. 4 hazard area discussions), additional characterization may be required to determine any final remedial action for that unit. DOE is committed to perform a re-evaluation of each deferred unit on an annual basis and submit to Ohio EPA for review and comment and will continue to do so until final disposition of all deferred units has been accomplished. The reevaluation is considered an Enforceable Milestone under the Ohio Consent Decree (DOE 2003h).

1.4 SUMMARY OF PORTS END STATE VISION

DOE's long-term vision for the site is evolving and will depend on future decisions by DOE that consider input from its stakeholders. DOE currently expects future land use at PORTS inside Perimeter Road to be controlled industrial based on USEC's January 2004 announcement of the American Centrifuge Uranium Enrichment Plant being located at PORTS; and commercial/recreational land use outside of Perimeter Road. In addition, Ohio EPA has asked DOE to evaluate land for future Natural Resource Damage Assessment (NRDA) consideration. It is believed that a mutually agreed upon ES Vision can be achieved that will both support critical missions at PORTS and ensure protection of human health and the environment.

> **Definition of ES Vision**
>
> ES Visions are representations of site conditions and associated information that reflect the planned future use of the property and are appropriately protective of human health and the environment consistent with that use. They form the basis for the exposure scenarios developed in baseline risk assessments that help establish remediation levels used in developing remedial alternatives in feasibility studies.

DOE has held two stakeholder meetings and two stakeholder workshops in an effort to: 1) inform the public as to what the ES Vision process is and why DOE is pursuing it; 2) receive input from stakeholders in creating the ES Vision and to receive stakeholder comment on draft versions of this document; and 3) inform its stakeholders how comments received on each draft version of this document were addressed. Appendix B chronicles all comments received, announcements sent, newspaper clippings of announcements, and attendance sheets for each public meeting and workshop throughout the development of the ES Vision. It should be noted that not all stakeholders agree with the ES Vision. As described earlier, the ES Vision is not a decision document and does not preclude continuing with existing regulatory agreements. Under the ES Vision:

- All land use inside Perimeter Road would be controlled industrial;

- Land use for areas where landfills and groundwater plumes exist outside of Perimeter Road would also be controlled industrial;

- Land use for all remaining areas outside of Perimeter Road would be either commercial or open space/recreational;

- Point of compliance for groundwater would be established at the DOE property boundary, rather than within the body of the contaminated plume to allow for monitored natural attenuation to occur;

- Groundwater within the DOE property boundary would continue to be restricted by the deed notation currently filed with Pike County. Thus, groundwater would continue to not be used for drinking or showering so on-site dermal and ingestion exposure pathways would not be completed, and MCLs would not be applicable.

- A risk range in groundwater of $1x10^{-4}$ to $1x10^{-6}$ would be achieved within the DOE property boundary;

- Institutional controls would remain in effect to control/restrict site access and land use such as at landfills and other solid waste management units (SWMU);

- Protect on- and off-site receptors (human and ecological) from unacceptable exposure; and

- Post-cleanup stewardship would involve risk assessment and would be protective of natural resources. Continued monitoring and engineering controls would be in place to ensure the protection of on-site workers, and the continued protection of the public and the environment.

The following is a summary that presents site options under consideration for DOE's long-term vision, as prescribed in the PORTS PMP (DOE 2003e). Long-term mission/vision are those activities projected for future or potential missions at the site through the 30-year planning period. Section 1.4.1 identifies the missions based on the assumptions in the current version of the Life-Cycle Baseline (LCB). These missions are subject to review and modification based on stakeholder input and changing conditions. Section 1.4.2 identifies other potential projects or actions that are being considered for beneficial use of the site that are also listed in the PMP.

1.4.1 Activities in the Current Life-Cycle Baseline

DOE requires development of LCBs that define activities at DOE sites for the foreseeable future. The baseline is used for long-term planning and for estimating budget requirements at all DOE facilities so that funding can be allocated appropriately among the facilities across the U.S. The PORTS LCB makes assumptions regarding the long-term vision at the site. The vision is under development and will be modified as appropriate to incorporate stakeholder inputs (See Sect. 4.4.3 of PMP (DOE 2003e)). The following assumptions were used in developing the current LCB schedule (DOE 2003e):

- Funding of ~$185 million per year would be available for DOE missions at PORTS.

- Cold standby would end in 2006. It is anticipated that D&D of GDP facilities would be completed in the future.

- A potential on-site waste disposal facility would be approved and utilized for D&D waste and environmental remediation waste.

- Current and deferred remedial actions would be complete.

- The DUF_6 would be converted through the DUF_6 Conversion Plant, the cylinders and uranium removed from the site, and the cylinder yards remediated as needed.

- Some facilities, such as the water treatment plant and the sewage treatment plant, would continue to operate.

- DOE would maintain control of, restrict access to, and provide for surveillance and maintenance of certain property and facilities such as the potential on-site waste disposal facility, other closed landfills, and groundwater extraction wells/treatment plants.

- The area inside Perimeter Road would be released for industrial development and DOE would specify and maintain any institutional controls needed to protect future industrial workers from any residual post-remediation contamination. Areas outside Perimeter Road would be released for commercial or industrial development and areas for recreational designations, and DOE would specify and maintain any institutional controls needed to protect future industrial workers and potential recreational users from any residual post-remediation contamination.

All of the above assumptions are subject to clarification or revision based on agreements with regulators and input from other stakeholders (see Sect. 4.4.3 of PMP (DOE 2003e)). The following subsections present the activities planned based on the assumptions in the current PORTS baseline.

1.4.1.1 D&D

D&D of the GDP will be a very large project (potentially the largest cleanup in Ohio) that will require a significant funding commitment from DOE (estimated at $1-2 billion) and create thousands of jobs over several years. Those facilities not intended for reindustrialization, reuse, continued operation, remediation, or long-term stewardship will be demolished. It is anticipated that the majority of GDP facilities will undergo D&D, and that the waste generated would be disposed of in a potential on-site waste disposal facility (see Sect. 1.4.1.3 below).

1.4.1.2 Potential on-site waste disposal facility

DOE is evaluating the costs, benefits, and concerns regarding construction of a potential on-site waste disposal facility at PORTS. Waste generated during plant D&D activities as well as waste resulting from deferred environmental remediation activities could be placed in such a facility. D&D and deferred remediation activities at PORTS are expected to generate approximately 3 million yd^3 of waste. These wastes will need to be managed in a responsible and cost-effective manner. Approval of a disposal facility at PORTS would require in-depth discussions with both local and state stakeholders and regulatory agencies. The current LCB assumes that such a facility will be approved, constructed, operated, and closed in accordance with regulatory requirements.

1.4.1.3 Long-term uranium management

During FY 2001, DOE/ORO prepared a Programmatic Environmental Assessment (DOE 2003f) to evaluate alternatives for the consolidation of reusable DOE uranium materials from various DOE sites in accordance with the National Environmental Policy Act (NEPA) and DOE's implementing procedures. DOE determined that an Environmental Assessment (EA), was the appropriate level of NEPA documentation due to the substantially reduced quantity of uranium materials (i.e., 8,000 metric tons versus original estimates of 40,000 metric tons) anticipated to be stored at the interim storage facility. This Programmatic Environmental Assessment was approved with a Finding of No Significant Impact. The Programmatic Environmental Assessment considers consolidation of uranium materials that have an asset value or potential future use for DOE or other federal agencies. PORTS was determined to be the preferred site for the storage of this material. DOE has developed a formal management plan for the uranium management mission that describes the strategy, organizational responsibilities, marketing plan, and integrated schedule through the year 2025. Current assumptions, however, are that this uranium material will be dispositioned by the end of 2009.

1.4.1.4 Infrastructure maintenance

As described in Sect. 3, DOE is responsible for maintenance of all facilities, systems, and property on the site that are not leased by others. Long-term surveillance and maintenance will continue as previously described for short-term requirements.

1.4.1.5 DUF_6 Conversion Facility operations

After construction and startup of the DUF_6 Conversion Facility, the conversion facility contractor will commence operations. Approximately 19,000 DUF_6 cylinders are stored at PORTS and another 6,000 cylinders are to be transported from Oak Ridge, Tennessee to PORTS. The conversion of the uranium in these cylinders to a more stable form is expected to take about 18 years.

1.4.2 Other Activities Under Consideration

Other opportunities for beneficial use of the Portsmouth Site and its facilities are under consideration as described below.

1.4.2.1 Advanced Enrichment Technology

A Memorandum of Agreement was signed between DOE and USEC on June 17, 2002, that establishes a framework for maintaining U.S. uranium enrichment capability for the foreseeable future, including a plan for deploying new enrichment technology. Under this agreement, USEC must begin commercial operations of a plant using advanced enrichment technology with a capacity of 1.0 million (expandable to 3.5 million) Separative Work Units per year either at the Portsmouth site by 2010 or the Paducah site by 2011. In December 2002, USEC selected PORTS for the advanced enrichment technology lead cascade demonstration facility. The existing PORTS GCEP buildings will be utilized for deployment of the new advanced technology. In January 2004, USEC announced plans for full deployment of the American Centrifuge Uranium Enrichment Plant at PORTS.

1.4.2.2 Reindustrialization

Reindustrialization is an innovative method to transfer underutilized facilities, equipment, and materials to the commercial sector to make them available for productive use. Once a more defined long-term mission has been developed for PORTS, reindustrialization could become an important component of the overall EM program. Benefits of reindustrialization include reuse of existing underutilized facilities and equipment, acceleration of cleanup actions, attraction of new industry to the region, and broadening of the economic base. The advanced centrifuge lead cascade demonstration facility will be reusing underutilized GCEP facilities at PORTS. The availability of rail access and high-voltage transmission lines may make the site attractive to certain industries.

1.4.2.3 Nuclear Power 2010 Initiative

DOE is studying the feasibility of developing a nuclear power plant using modern, intrinsically safe technology. The proposed startup date would be 2010, and the plant would be the first nuclear power plant to be constructed in the U.S. since the 1970s. In 2002, PORTS was listed as one of three sites considered due to its adequate land, water resources, power availability, and availability of trained nuclear workers. The Nuclear Power 2010 Study indicates that PORTS is second in consideration for this initial nuclear power plant. The site could conceivably be a viable location for a future nuclear power plant.

2. REGIONAL CONTEXT END STATE DESCRIPTION

This chapter describes the ES Vision in regional context to portray PORTS within its larger contiguous regional area. It is intended to characterize PORTS' relationship to possible off-site pathways and human or ecological receptors of concern. The maps provided for this section include the boundaries of all local and county governments, population centers, transportation and infrastructure, land cover, ecological activities, and other off-site features or areas that could be affected, in the unlikely event that contamination would migrate from the site. Maps and discussions are provided for both current state and ES Vision.

Two regional extents are described in this chapter. Sections 2.1 and 2.2 present PORTS within a four county (Pike, Scioto, Ross, and Jackson) region, which is consistent with the community reuse organization SODI. Section 2.3 provides a custom configuration for the associated maps that presents PORTS within a 10-mile radius to adequately show the level of detail necessary within its immediate surrounding area. Note that distance measurements discussed in this document are a combination of straight line map distances, as measured by the PORTS GIS, and driving distances, as cited from other PORTS documents.

2.1 PHYSICAL AND SURFACE INTERFACE

Information discussed in this section and depicted on the associated maps provides the regional administrative boundaries, major transportation and infrastructure features, major surface configuration features, and significant hazard areas at PORTS for both the current state and ES Vision. For this discussion, administrative boundaries include city, county, and state governments; federal and state properties, including the PORTS DOE property boundary; and private or government legal ownership. Transportation and infrastructure features include major highways, roads, railroads, airports, dams, and power plants. Surface configuration features include topography, lakes, rivers, and streams. Potential on- and off-site hazard areas of concern are also included.

2.1.1 Current State

The following sections reference Fig. 2.1a, which depicts all physical and surface features within the regional context under current conditions.

2.1.1.1 Administrative boundaries

As depicted in Fig. 2.1a, PORTS is located in a rural area of south central Pike County in southern Ohio. Ross County is located to the north, Jackson County to the east, Scioto County to the south, and Highland and Adam Counties to the west. The nearest residential center to PORTS is Piketon, which is approximately 5 miles north of the facility on U.S. Route 23. The largest community in Pike County is Waverly, approximately 10 miles north of the facility. Additional population centers in proximity to the DOE facility include Portsmouth (27 miles south), which lies on the Ohio River, Chillicothe (27 miles north), and Jackson (28 miles east). There are no tribal nations within the PORTS region.

PORTS is situated on a 3,714-acre parcel of DOE-owned property. Approximately 1,200 acres of this property are located within the facility's Perimeter Road, which comprises the centrally developed area. Approximately 500 acres within Perimeter Road are fenced for controlled access. There are approximately 190 buildings, support facilities, equipment storage areas, waste management units, and numerous utilities and infrastructure. The entire DOE boundary is fenced. Federally owned Wayne National Forest encompasses most of the eastern portion of the regional extent and the State of Ohio owns several state forests that lie to the north, west and south of the facility, with Shawnee State Forest just west of Portsmouth as the largest of the state-owned land. Scioto Trails State Forest and Park is located roughly 8.75 miles north of PORTS.

2.1.1.2 Transportation and infrastructure

As depicted in Fig. 2.1a, there is one federal highway (U.S. Route 23) and one state highway (State Route 32) serving the PORTS area. Both highways are located within one mile of PORTS. Both routes are four-lane highways, with U.S. Route 23 traversing north-south in parallel with the Scioto River and State Route 32 traversing east-west. PORTS is located 3.5 miles southeast of the interchange between U.S. Route 23 and State Route 32. U.S. Route 23 has an average daily traffic volume of 13,990 vehicles. State Route 32 has an average daily traffic volume of 7,420 vehicles. Traffic in both directions is included in these values. U.S. Route 23 is at 60% of its design capacity. State Route 32 is at 40% of its design capacity. The Ohio Department of Transportation (ODOT) supplied these data from a 1999 traffic study. A load limit of 85,000-lb gross vehicle weight is required by the Ohio Revised Code (ORC) on these routes. Special overload permitting is available. (DOE 2003f)

PORTS has excellent rail access, and several track configurations are possible within the site. The Norfolk Southern rail line is connected to PORTS via a rail spur entering the northern portion of the site. The on-site rail system is used primarily for the transport of scrap material offsite in intermodal containers. The GCEP area is also connected to the existing rail configuration. Track in the vicinity of Piketon, Ohio allows a maximum speed of 60 miles per hour.

PORTS is relatively isolated from commercial air service; however, a few small regional and county airports do exist, such as the Pike County Airport, which is located roughly 8 miles northeast of Waverly near the northern Pike County border (Fig. 2.1a). The closest commercial air service to PORTS is the Port Columbus International Airport in Columbus, Ohio approximately 75 miles north of the facility.

As noted above, PORTS is approximately 27 miles north of the Ohio River, which is navigable along its entire length. PORTS can be served by barge transportation via the Ohio River at the ports of Wheelersburg, Portsmouth, and New Boston (not shown within the regional extent). The Portsmouth Barge Terminal Bulk Materials Handling Facility is available for bulk materials and heavy unit loads. All heavy-unit loading is done by mobile crane or barge-mounted crane at an open air terminal. The Ohio River provides barge access to the Gulf of Mexico via the Mississippi River or the Tennessee-Tombigbee Waterway. Travel time to New Orleans is 14 to 16 days; to St. Louis, 7 to 9 days; and to Pittsburgh, 3 to 4 days. The U.S. Army Corps of Engineers (USACE) maintains the Ohio River at a minimum channel width of 800 ft and a minimum depth of 9 ft. (DOE 2003f)

2.1.1.3 Surface configuration

PORTS is located in the northwest portion of the unglaciated Appalachian Plateau physiographic province, adjacent to the glaciated Appalachian Plateau physiographic province. Bedrock in the PORTS area is composed of Mississippian age shale and sandstone. PORTS is situated atop a sedimentary sequence filling the ancestral Portsmouth River Valley. As a result, the vicinity of the site is characterized by low relief. Cut and fill activities and ground leveling associated with construction of PORTS are also significant contributors to the low topographic relief in the immediate area. In the surrounding hills of the unglaciated plateau, the degree of relief is significantly greater at over 250 ft (DOE 2003f). Another area of low relief is located in the Scioto River floodplain to the west of the site. The PORTS area is characteristic of a dendritic drainage pattern.

Major rivers flowing within this region are the Ohio River, which is located approximately 20 miles to the south and forms the southern boundary of Ohio, and the Scioto River, which is located less than 0.5 mile to the southwest (at its closest point) and flows from north to south, draining into the Ohio River at Portsmouth, Ohio. Little Beaver Creek is the largest of the streams within PORTS and flows from east to west into Big Beaver Creek before discharging into the Scioto River.

2.1.1.4 Hazard areas of concern

As depicted in Fig. 2.1a, very little development exists within the regional extent; therefore, most of the hazard areas in the region are contained within PORTS. The Pike County Solid Waste Landfill is located approximately 5 miles north of the facility. No nuclear or coal fired power plants or National Priority List (NPL) sites exist within the four-county region. PORTS hazard-specific areas of concern are not shown on Fig. 2.1a due to the large extent of the four-county regional area; however, these hazard areas are shown in the custom configuration 10-mile radius Fig. 2.3a1, as well as the hazard-specific maps associated with Chap. 4.

2.1.2 ES Vision

The following sections reference Fig. 2.1b, which depicts all physical and surface features within the regional context under the ES Vision.

2.1.2.1 Administrative boundaries

As depicted in Fig. 2.1b, it is not anticipated that administrative boundaries within the four-county region will change to any measurable difference within the planning period.

2.1.2.2 Transportation and infrastructure

As depicted in Fig. 2.1b, it is not anticipated that transportation and infrastructure within the four-county region will change to any great extent within the planning period. According to the Ohio Department of Transportation, the only anticipated change to note is a 16-mile Portsmouth bypass in Scioto County, expected to be constructed between 2006 and 2015 (ODOT 2004) (Fig. 2.1b).

2.1.2.3 Surface configuration

As depicted in Fig. 2.1b, it is not anticipated that surface configuration features within the four-county region will change to any measurable difference within the planning period.

2.1.2.4 Hazard areas of concern

As depicted in Fig. 2.1b, it is not anticipated that hazard areas of concern within the four-county region will change to any measurable difference within the planning period.

2.2 HUMAN AND ECOLOGICAL LAND USE

Information discussed in this section and depicted on the associated maps provides the regional human activities, land cover, and ecological activities at PORTS for both the current state and ES. For this discussion, human activities include population centers, schools, airports, hospitals, and cemeteries. Land cover depictions are based on area usage and include: residential, commercial/industrial/

transportation, manufacturing, open space/recreational/vegetated, agricultural, restricted access, ecological/preservation, wetlands, water and barren. Ecological activities include ecological/preservation areas, watershed delineations, and biota habitats. Potential off-site hazard areas of concern are depicted on the maps associated with this section; however, no discussion is provided, as this information was discussed in Sect. 2.1. As discussed in Sect. 2.1, PORTS hazard areas of concern are not shown on Figs. 2.2a and 2.2b due to the large extent of the four-county regional area; however, these hazard areas are shown in the custom configuration 10-mile radius Figs. 2.3a1 and 2.3b1, as well as the hazard-specific maps associated with Chap. 4.

It should be noted that specific land parcel data was only available electronically for Pike, Ross, and Jackson Counties within the four-county area that makes up the regional extent. An attempt was made to obtain parcel data for Scioto County; however, the information available is all paper based and requires extensive work to convert to electronic geographically referenced data. Statewide electronic data was obtained by the Ohio Department of Natural Resources (ODNR) for land use/land cover and is used in all areas outside of Pike, Ross, and Jackson Counties. However, according to ODNR, one data set combines "cropland and pasture, parks, golf courses, lawns and similar grassy areas" and that agricultural data cannot be separated out from this data set. This is due to the way data were collected and interpreted. The data were extracted from a 1994 statewide land cover inventory produced by digital image processing of Landsat Thematic Mapper Data, which is a multi-spectral scanner that collects electromagnetic radiation reflected from the earth's surface in the visible, near- and mid-infrared wavelengths and is interpreted into 30 meter by 30 meter spectral classes. Thus, there is no accurate way to differentiate agriculture from other vegetation in this data set that is used outside of Pike, Ross, and Jackson Counties.

2.2.1 Current State

The following sections reference Fig. 2.2a1, which depicts the human and ecological land use, land cover, and ecological activities information within the regional context under current conditions. Note that Fig. 2.2a2 was included to provide additional context by draping the human and ecological land use data over the topography (i.e., hill shade) to show how the topography influences the land use in this area.

2.2.1.1 Human activities

As depicted in Figs. 2.2a1 and 2.2a2, PORTS is located in rural south central Pike County in southern Ohio. The nearest population center to PORTS is Piketon, which is approximately 5 miles north of the facility on U.S. Route 23. The largest population center in Pike County is Waverly, approximately 10 miles north of the facility. Additional population centers in proximity to the DOE facility include Portsmouth (27 miles south), which lies on the Ohio River, Chillicothe (27 miles north), and Jackson (28 miles east). Note that Sects. 2.3.4 and 3.4 detail the breakdown of the population density within the surrounding area and site, respectively.

2.2.1.2 Land cover

As depicted in Figs. 2.2a1 and 2.2a2, land cover in the four-county region is predominantly agricultural with open space/recreational/vegetated use to a lesser extent. Residential areas are sparse and there is very little manufacturing in the region. With the exception of PORTS, there is very little commercial/industrial/transportation land use in the region.

2.2.1.3 Ecological activities

As depicted in Figs. 2.2a1 and 2.2a2, ecological activities within the regional extent are dominated by agricultural use. There are a number of small wetlands along the Scioto River and its many tributaries.

A large 100-year floodplain extends along the extent of the Scioto River Valley within the region and extends roughly 2,100 ft onto the DOE property along Little Beaver Creek.

PORTS is located within the 8-digit regional watershed designation 05060002 and lies within 2.5 miles northwest of the 8-digit regional watershed designation 05090103. The DOE property splits two subregional watersheds: 120 to the north and 160 to the south with subregion 130 approximately 0.2 miles to the west. (USDA 2004).

2.2.1.4 Hazard areas of concern

As discussed in Sect. 2.1.1.2, very little development exists within the regional extent; therefore, most of the hazard areas in the region are contained within PORTS. The Pike County Solid Waste Landfill is located approximately 5 miles north of the facility. No nuclear or coal fired power plants or NPL sites exist within the four-county region. PORTS contaminated areas of concern are not shown on Figs. 2.2a1 and 2.2a2 due to the large extent of the four-county regional area; however, these hazard areas are shown in the custom configuration 10-mile radius Figs. 2.3a2a and 2.3a2b, as well as in the site hazard-specific maps provided in Sect. 4.

2.2.2 ES Vision

The following sections reference Fig. 2.2b, which depicts the human and ecological land use, land cover, and ecological activities information within the regional context under the ES Vision.

2.2.2.1 Human activities

As depicted in Fig. 2.2b, it is not anticipated that human activities within the four-county region will change to any measurable difference within the planning period.

2.2.2.2 Land cover

As depicted in Fig. 2.2b, it is not anticipated that land cover features within the four-county region will change to any measurable difference within the planning period.

2.2.2.3 Ecological activities

As depicted in Fig. 2.2b, it is not anticipated that ecological activities within the four-county region will change to any measurable difference within the planning period.

2.2.2.4 Hazard areas of concern

As depicted in Fig. 2.2b, it is not anticipated that hazard areas of concern within the four-county region will change to any measurable difference within the planning period.

2.3 CUSTOM CONFIGURATION – 10 MILE RADIUS

This section provides a custom configuration that presents PORTS within a 10-mile radius to adequately show the information depicted in Sects. 2.1 and 2.2 at a level of detail necessary within PORTS' immediate surrounding.

2.3.1 Surrounding Physical and Surface Interface

2.3.1.1 Current state

Figure 2.3a1 depicts the physical and surface features within a 10-mile radius under current conditions. In addition to the regional physical and surface interface information depicted on Fig. 2.1a, Fig. 2.3a1 shows the water supply wells X-605 (six wells in the northern well field), X-608 (55 wells in the middle well field), and X-6609 (36 wells in the southern well field) that are pumped from the Scioto River to the plant. There are also 57 known private domestic wells within 5,000 ft of the DOE boundary. The water supply, power transmission, and natural gas lines are also depicted for the site.

2.3.1.2 ES Vision

As depicted in Fig. 2.3b1, it is not anticipated that the physical and surface interface features within a 10-mile radius of PORTS will change to any measurable difference within the planning period.

2.3.2 Surrounding Human and Ecological Land Use

2.3.2.1 Current state

Figures 2.3a2a and 2.3a2b depict the human and ecological land use within a 10-mile radius under current conditions. As with Sect. 2.1, Fig. 2.3a2b was included to provide additional context by draping the human and ecological land use data over the topography to show how the topography influences the land use in the area.

The nearest schools to PORTS are the Vern Riffe Joint Vocational School (approximately 0.7 miles north of the DOE boundary) and the Miracle City Academy associated with the Word Alive Fellowship Church (approximately 0.8 miles northeast of the DOE boundary). The Piketon Elementary and High Schools are located within Piketon roughly 1.7 and 1.8 miles north of the DOE boundary, respectively. The nearest hospital to PORTS is the Pike Community Hospital located just south of Waverly approximately five miles north of the DOE boundary.

There are 69 cemeteries within a 10-mile radius of PORTS, most of which are very small and not active. The Daniels, Lucas, and Brust Number 2 cemeteries are located within 1-1.5 miles northwest of the DOE property. The James and Hawk cemeteries are located 1.5 and 0.3 miles, respectively, to the east, and the Haskind Cemetery is located roughly one mile to the southeast of the DOE property boundary.

As discussed in Sect. 2.2, the area is predominantly agricultural with some open space/recreational/vegetated use to a lesser extent. Residential areas are sparse and there is very little manufacturing in the region. Southern Wood Piedmont Company, located roughly two miles north of PORTS, and Mills Pride, a cabinet manufacturing company located roughly 5 miles north of PORTS in Waverly, make up the bulk of manufacturing in the area. With the exception of PORTS, there is very little commercial/industrial/transportation land use in the region.

As discussed in Sect. 2.2.1.3, PORTS is located within the 8-digit regional watershed designation 05060002 and lies within 2.5 miles northwest of the 8-digit regional watershed designation 05090103. The DOE property splits two subregional watersheds: 120 to the north and 160 to the south with subregion 130 approximately 0.2 miles to the west. (USDA 2004).

2.3.2.2 ES Vision

As depicted in Fig. 2.3b2, it is not anticipated that human and ecological land use within a 10-mile radius of PORTS will change to any measurable difference within the planning period.

2.3.3 Surrounding Legal Ownership

2.3.3.1 Current state

As depicted on Fig. 2.3a3, PORTS is surrounded entirely by privately owned land. Federally owned Wayne National Forest occupies most of the eastern portion of the site extent. Scioto Trails State Forest and Park is located roughly 8.75 miles north of PORTS. The State of Ohio owns a portion of land just north of PORTS used for the Ohio State University South Centers Research and Extension Office.

2.3.3.2 ES Vision

As depicted in Fig. 2.3b3, it is not anticipated that the legal ownership of land within a 10-mile radius of PORTS will change to any measurable difference within the planning period.

2.3.4 Surrounding Demographics

Population trends and projections for each of the counties in the region are presented in Table 2.1. Of the four counties, Scioto and Ross Counties have the largest populations, accounting for 37% and 34%, respectively, of the region's population in 2000. Jackson County accounts for 15%, and Pike County accounts for the smallest population at 13%. The Ohio State University Extension Data Center projects that the population in the region will grow by about 8.6% between 2000 and 2030, compared to a statewide average of 7.8% growth. More than 70% of the projected population growth is expected to occur in Ross County between 2000 and 2030 (OSU 2004).

Table 2.1. Population trends and projections

County	1990	2000	2010	2020	2030
Jackson	30,230	32,641	34,022	35,057	35,678
Pike	24,249	27,695	29,766	31,081	31,555
Ross	69,330	73,345	78,380	82,931	87,433
Scioto	80,327	79,195	78,823	78,327	78,265
Region	204,136	212,876	220,991	227,396	232,931
State	10,847,115	11,353,140	11,666,854	12,005,733	12,317,613

Sources: Bureau of the Census 2004; Ohio State University Extension Data Center 2004; Ohio Department of Development 2004.

2.3.4.1 Current state

As depicted on Fig. 2.3a4, the population density within a 10-mile radius of PORTS is relatively low. The highest population concentration in this area is located on the north side of Waverly at a range of 1,000-5,000 per square mile. Piketon and Lucasville have a population density range of 500-1,000. The population density of the remaining 10-mile radius ranges between 0-500.

2.3.4.2 ES Vision

As depicted in Fig. 2.3b4, as well as in Table 2.1 above, it is not anticipated that the population density within a 10-mile radius of PORTS will change to a great enough extent so as to change the population density range designations on these figures within the planning period.

3. SITE CONTEXT END STATE DESCRIPTION

In contrast to Chap. 2, which portrays PORTS in a regional context, Chap. 3 describes the PORTS ES Vision within a site context and presents information similar to that provided in Chap. 2, but at a greater level of detail specific to the site. The information presented in this chapter is intended to describe all areas and human and ecological receptors of concern at and around PORTS that might be affected, in the unlikely event contamination migrated from the site. The maps presented in this section portray PORTS within the boundaries of all contiguous land around the DOE property and depict the physical and surface interface, human and ecological land use, legal ownership, and demographics for both current state and ES Vision. Note that distance measurements discussed in this document are a combination of straight line map distances, as measured by the PORTS GIS, and driving distances, as cited from other PORTS documents.

3.1 PHYSICAL AND SURFACE INTERFACE

The physical and surface interface information discussed in this section and depicted on Figs. 3.1a and 3.1b display in detail from a site context the information discussed and depicted in the custom configuration Sect. 2.3.

3.1.1 Current State

The following sections reference Fig. 3.1a, which depicts all physical and surface interface features within the site context under current conditions.

3.1.1.1 Administrative boundaries

As depicted on Fig. 3.1a, no incorporated towns or cities are visible within the extent of the site-context map; however, as discussed in Sect. 2.1, the Village of Piketon is located roughly five miles north of PORTS.

As discussed in Sect. 2.1, PORTS is situated on a 3,714-acre parcel of DOE-owned property. Approximately 1,200 acres of this property are located within the facility's Perimeter Road, which comprises the centrally developed area. Approximately 500 acres within Perimeter Road are fenced for controlled access. The entire DOE boundary, which encompasses the main fenced security area, is also controlled by a security fence.

PORTS is surrounded entirely by privately owned land. Federally owned Wayne National Forest occupies most of the eastern portion of the site extent. The State of Ohio owns a portion of land just north of PORTS that is used for the Ohio State University South Centers Research and Extension Office. There are some archaeological and historic locations throughout the site, most of which are historic farmsteads. Two cemeteries are located within the DOE boundary: Holt Cemetery, located roughly 500 feet from the northeast corner of the DOE boundary; and Mount Gilead Cemetery, located roughly 2,700 feet off the northeast corner of Perimeter Road. There are two cemeteries located adjacent to the DOE boundary: Daley Cemetery, located adjacent to the DOE-owned property to the west; and Bailey Chapel Cemetery, located adjacent to the DOE boundary on the southeast corner of PORTS.

3.1.1.2 Transportation and infrastructure

The secured area at PORTS is encompassed by Perimeter Road, which makes roughly a seven-mile loop around the facility. Under current security conditions, PORTS is only accessible by the Principal (west) Access Road: a four-lane interchange with U.S. Route 23 located to the west of the facility. Three other access roads exist and have served PORTS in the past. The North Access Road is a two-lane road transitioning to four lanes with an at-grade interchange with State Route 32. The East Access Road is a two-lane county road that disperses traffic to a county road network east and southeast of PORTS. State Route 32 is also accessible from this network. The South Access Road is a two-lane road that disperses traffic to the south and southeast and intersects U.S. Route 23 south of the facility. Note that while the North, South, and East Access Roads are closed under current security conditions, each of these roads offers viable access to PORTS under future use scenarios. (DOE 2003f)

As discussed in Sect. 2.1, the Norfolk Southern rail line is connected to PORTS via a rail spur entering the northern portion of the site. The on-site rail system is used primarily for the transport of scrap material offsite in intermodal containers. The GCEP area is also connected to the existing rail configuration. Track in the vicinity of Piketon, Ohio allows a maximum speed of 60 miles per hour.

There are approximately 190 buildings, support facilities, equipment storage areas, waste management units, and numerous utilities and infrastructure that make up PORTS.

PORTS is currently supplied electricity through the transmission lines supplied by the Ohio Valley Electric Corporation (OVEC) under a contract that provides for “arranged power” until PORTS is able to secure permanent arrangements through other sources. OVEC operates two coal-fired power plants (located outside of the four-county regional extent) that were built for and dedicated to serving PORTS. Their combined generating capacity is comparable to the PORTS design load of 2260 megawatts (MW) although the previous DOE-OVEC contract called only for a firm power supply of 1940 MW. With the gaseous diffusion facilities now in cold standby, the current power consumption is much less. According to the DOE-USEC lease agreement, DOE continues to administer the power arrangements that supply electric service to PORTS. USEC pays DOE for purchased power, and DOE then pays the power suppliers. (DOE 2003f)

Natural gas service is available from Pike Natural Gas Company’s main gas line located north of PORTS. As part of the winterization activities associated with the cold standby of the GDP, a 100-pounds per square inch (psi) natural gas main has been routed from the main line to a new hot water boiler system in Building X-3002.

PORTS water supply is served by three well fields that pump water from the Scioto River. Water supplied from the X-605 and X-608 well fields are pumped through a 10-in. plastic tie line into a main 48-in. reinforced concrete line. Water supplied from the X-6609 well field, constructed to supply water to the GCEP, is pumped through a 30-in. reinforced concrete line. The water supply lines feed into the X-611 Water Treatment Plant on site where the water is treated with lime to remove a major portion of its carbonate hardness and a polymer for coagulation of precipitated solids. Following the softness treatment during production, the treated water flows directly into basins of the GDP cooling towers to “make-up” for evaporation and blowdown losses from the recirculated cooling water system and GCEP cooling system. The X-611 Water Treatment Plant also provides sanitary water for the facility with additional treatment of the water that includes a pH adjustment, a phosphate compound treatment for corrosion control, and a sand filtration to minimize suspended solids and bacteria. (DOE 2003f)

The X-6619 Sewage Treatment Plant utilizes aerobic digesters, aeration tanks, clarifiers, filters, and an activated sludge process to provide adequate sewage treatment for PORTS. Following post-chlorination, dechromanation, and effluent monitoring, treated wastewater flows directly to the Scioto River through a pipeline. Dried digested sludge is containerized in 55-gal drums and is stored as low-level waste on-site pending subsequent disposal at Envirocare in Utah. (DOE 2003f)

3.1.1.3 Surface configuration

As discussed in Sect. 2.1, the land within Perimeter Road at PORTS is characterized by cut and fill activities and ground leveling associated with construction of PORTS, which contributed to the low topographic relief in the immediate area. In the surrounding hills of the unglaciated plateau, the degree of relief is significantly greater at over 250 ft (DOE 2003f). Note that the eastern 0.5 half mile of Fig. 3.1a appears “pixilated” relative to the rest of the figure. This is due to the difference between the site elevation data, which is derived from a 1993 site flyover creating a highly resolved data set; and the regional data, which is a 30 meter by 30 meter resolution Digital Elevation Model (DEM) data set from the United States Geological Survey (USGS) interpreted from Landsat imagery.

As depicted on Fig. 3.1a, the Scioto River, which flows from north to south on the west side of the facility, is closest to PORTS (less than 0.5 miles) at the southwest corner of the DOE boundary. Little Beaver Creek flows from the west side of the DOE boundary northward and cuts westward across the site north of Perimeter Road and flows into Big Beaver Creek offsite before discharging into the Scioto River.

3.1.1.4 Hazard areas of concern

The five onsite TCE-contaminated groundwater plumes are depicted on Fig. 3.1a showing the groundwater flow. The X-701B plume flows to the east; the X-740 and Quadrant II 7-Unit plumes both flow to the northwest; the Quadrant I 5-Unit and X-749/X-120 plumes are flowing to the south-southwest at this time. No TCE-contaminated groundwater plumes are migrating off site. Note that Chap. 4 maps depict all hazard areas of concern within the site extent.

3.1.2 ES Vision

The following sections reference Fig. 3.1b, which depicts all physical and surface interface features within the site context under the ES Vision.

3.1.2.1 Administrative boundaries

As depicted in Fig. 3.1b, it is not anticipated that administrative boundaries within or around the site will change to any measurable difference within the planning period. The land outside Perimeter Road is anticipated to be designated commercial/recreational and it is not anticipated that land ownership will change.

3.1.2.2 Transportation and infrastructure

As depicted in Fig. 3.1b, it is not anticipated that transportation and infrastructure within or around site will change to any measurable difference within the planning period.

3.1.2.3 Surface configuration

As depicted in Fig. 3.1b, it is not anticipated that surface configuration features within or around the site will change to any measurable difference within the planning period.

3.1.2.4 Hazard areas of concern

As depicted in Fig. 3.1b, the only major difference in the site physical and surface interface under the ES Vision is the addition of a potential on-site waste disposal facility.

3.2 HUMAN AND ECOLOGICAL LAND USE

The human and ecological land use information discussed in this section and depicted on Figs. 3.2a and 3.2b display in detail from a site context the information discussed and depicted in the custom configuration Sect. 2.3.

3.2.1 Current State

The following sections reference Fig. 3.2a, which depicts all human and ecological land use features within the site context under current conditions.

3.2.1.1 Human activities

As depicted on Fig. 3.2a, there are no schools located within the site extent. The nearest schools to PORTS are the Vern Riffe Joint Vocational (approximately 0.7 miles north of the DOE boundary) and the Miracle City Academy associated with the Word Alive Fellowship Church (approximately 0.8 miles northeast of the DOE boundary). As discussed in Sect. 2.3, the Piketon Elementary and High Schools are located within Piketon roughly 1.7 and 1.8 miles north of the DOE boundary, respectively. The nearest hospital to PORTS is the Pike Community Hospital located just south of Waverly approximately five miles north of the DOE boundary.

There are some archaeological and historic locations throughout the site, most of which are historic farmsteads. Two cemeteries are located within the DOE boundary: Holt Cemetery, located roughly 500 feet from the northeast corner of the DOE boundary; and Mount Gilead Cemetery, located roughly 2,700 feet off the northeast corner of Perimeter Road. There are two cemeteries located adjacent to the DOE boundary: Daley Cemetery, located adjacent to the DOE-owned property to the west; and Bailey Chapel Cemetery, located adjacent to the DOE boundary on the southeast corner of PORTS.

PORTS is surrounded mostly by agricultural use with some open space/recreational/vegetated and residential use to a lesser extent. There is no manufacturing within the site extent and commercial/ industrial/transportation use is very sparse. With the exception of PORTS, the only commercial use that exists within the site extent is located to the west of PORTS along U.S. Route 23.

Currently, all land within the DOE property is secured by a fence.

3.2.1.2 Land cover

As depicted on Fig. 3.2a, there is a barren area in the northeast corner of the DOE-owned property that was used for fill material. The X-611A prairie land and wetlands is designated as ecological/preservation. The X-611B Sludge Lagoon is the largest water body on site. A 100-year floodplain exists for roughly 0.25 miles at the northwest corner of the DOE property along Little Beaver Creek.

3.2.1.3 Ecological activities

As discussed above, X-611A is designated as ecological/preservation, as it has been set aside as prairie land and wetlands. As discussed in Sect. 2.2 and 2.3, PORTS is located within the 8-digit regional watershed designation 05060002 and lies within 2.5 miles northwest of the 8-digit regional watershed designation 05090103. The DOE property splits two subregional watersheds: 120 to the north and 160 to the south with subregion 130 approximately 0.2 miles to the west. (USDA 2004).

3.2.1.4 Hazard areas of concern

As depicted on Fig. 3.2a, the X-701B plume flows to the east; the X-740 and Quadrant II plumes flow to the northwest; the Quadrant I and X-749 plumes are flowing to the south-southwest. No TCE-contaminated groundwater plumes are anticipated to migrate off site. Note that Chap. 4 maps depict all hazard areas of concern within the site extent.

3.2.2 ES Vision

The following sections reference Fig. 3.2b, which depicts all human and ecological land use features within the site context under the ES Vision.

3.2.2.1 Human activities

As depicted on Fig. 3.2b, the commercial/industrial/transportation area is expected to be within Perimeter Road. No other human activities are anticipated to change within the planning period.

3.2.2.2 Land cover

As depicted on Fig. 3.2b, the land cover is not anticipated to change to any measurable difference within the planning period.

3.2.2.3 Ecological activities

As depicted on Fig. 3.2b, ecological activities are not anticipated to change to any measurable extent within the planning period.

3.2.2.4 Hazard areas of concern

As depicted in Fig. 3.2b, it is not anticipated that the groundwater plumes will change to any measurable difference within the planning period.

3.3 LEGAL OWNERSHIP

Information in this section discusses and depicts the legal ownership of areas at and around PORTS under the current state and ES Vision. The ownership (surface and subsurface) classes considered are private and government (i.e., state, federal, and local).

3.3.1 Current State

As depicted on Fig. 3.3a, the entire DOE boundary is federally owned by DOE and ownership of land within and around PORTS is privately owned.

3.3.2 ES Vision

As depicted on Fig. 3.3b, ownership of land around PORTS is not anticipated to change to any measurable difference and DOE will retain ownership of its property within the planning period.

3.4 DEMOGRAPHICS

Material in this section discusses and depicts the population density and other related demographic information for the PORTS area under the current state and ES Vision. Demographic data presented includes population data and housing and socioeconomic data obtained by the 2000 Census.

3.4.1 Current State

As depicted on Fig. 3.4a, the population density immediately surrounding PORTS is sparsely populated at 0-150 per square mile.

3.4.2 ES Vision

As shown on Table 2.1 in Sect. 2.3.4, the population density in Pike County is expected to grow roughly 12% between 2000 and 2030, compared to an expected regional growth of 8.6% during this period (OSU 2004). Thus, the growth will not change to a great enough extent to change the population density range designations on Fig. 3.4b.

3.5 CUSTOM CONFIGURATION – SITE HABITAT

3.5.1 Current State

Figure 3.5a provides a map showing the PORTS site habitat, as identified in the *Wetland Survey Report for the Portsmouth Gaseous Diffusion Plant* (DOE 1996a).

3.5.2 ES Vision

As depicted on Fig. 3.5b, habitat in the locations labeled as "possible location for a potential on-site waste disposal facility" could change, in the event that an on-site waste disposal facility is constructed at one of these possible locations.

4. HAZARD-SPECIFIC CONTEXT END STATE DESCRIPTION

This chapter presents the hazard-specific context ES Vision description and provides the greatest level of detail for key hazard areas of concern at PORTS. The discussions herein present the specific information necessary to qualify or quantify the nature of the hazard present, the potential of the hazard to have an impact (and degree of impact) on human health and the environment, and any mitigation of the hazard identified. Hazard-specific maps, CSMs and Treatment Trains are presented for the current state, ES Vision, and current baseline end state, and are used to support the variance discussion presented in Chap. 5.

> This chapter presents potential actions to address hazards that could be used to reach the ES Vision. These presentations are not meant to be pre-decisional but are meant to introduce examples of actions the may be completed to reach the ES Vision. The selection of specific actions would be made in accordance with applicable law and agreements.

The CSMs presented are intended to communicate risk information to DOE managers, the regulatory community, and the general public. They provide summary level information regarding the hazard areas, pathways, receptors, and barriers (if applicable) between hazards and the receptors. Each CSM has five major elements:

1. A description of the hazard area of concern being depicted in the map;
2. Identification of the primary and secondary sources of contamination;
3. Identification of the current and potential future release, transport, and exposure mechanisms;
4. Identification of the current and potential future receptors believed to be at risk; and
5. Identification of current and planned barriers or mechanisms that will prevent or limit potential exposure to at-risk receptors.

The CSMs were developed following guidance presented in American Standards and Testing Materials Standard E 1689-95, *Standard Guide for Developing Conceptual Site Models for Contaminated Sites*, as extended by the DOE guidance material concerning development of risk-based end state visions (DOE 2003c) and its associated clarification memorandum (DOE 2003d). The risk numbers and concentrations are taken from the Quadrant RFI Reports (DOE 1996c, d, e, f) and the *Plant-Wide Baseline Human Health Risk Assessmen*t (MMES 1995), which are the most recent risk assessments to delineate risk by SWMU at PORTS.

As noted above, the CSMs are presented for current state, ES Vision, and current baseline end state for each hazard area. The goal of this presentation is to highlight the current protective mechanisms in place at each hazard site (if any exist) and the additional mechanisms that are anticipated to be included, should the ES Vision be attained. The purpose of the CSMs, therefore, is to clarify what already has been done at each hazard area and what DOE would intend to do to manage potential and actual risks to attain the ES Vision.

The narrative that accompanies the CSMs are not meant to be a predetermined course of action, but rather a description of the mechanisms envisioned to be in place, should the ES Vision be attained. Discussion of potential specific mechanisms is necessary to provide an analytical framework and is not meant to be pre-decisional. As noted in Chap. 1, the selection of specific actions will be made in the appropriate decision documents after receipt of stakeholder and regulatory input, as required in accordance with applicable laws, regulations, and agreements.

Treatment Trains are provided to present the expected treatment of each hazard under the ES Vision and current baseline end state and to indicate which receptors might be exposed as a result of the treatment presented. In addition, the Treatment Trains indicate where an exposure might occur and at which step in the treatment process it might occur. This is also discussed in the text for both ES Vision and current baseline end state for each hazard area.

Eight hazard areas are considered in this chapter. These hazard areas (Figures 4.0a & 4.0b) were developed to be consistent with the PORTS site mission and cleanup strategy presented in Chap. 1 and are as follows:

- Hazard Area 1 (Groundwater Plumes and Sources): This hazard area is comprised of the groundwater beneath PORTS and encompasses the sources of contamination to groundwater, the dissolved phase plumes, and dense non-aqueous phase liquid (DNAPL). Note that while on-site landfills are considered sources of contamination to groundwater and are discussed as such in the hazard area, for the purpose of this document, a landfill-specific discussion as a hazard area is also presented in Sect. 4.3, as landfills present potential risk beyond those specific to groundwater.

- Hazard Area 2 (Surface Soil Contamination and Sources): This hazard area is comprised of units that make up the surface soil contamination. It encompasses all areas containing soil contamination that are not associated with groundwater plumes, landfills or the surface water hazard areas. As depicted later in this chapter, this hazard area includes all areas inside the industrialized portion of PORTS that are not part of other hazard areas and includes the switchyards and transformer storage and cleaning facilities.

- Hazard Area 3 (Landfills): This hazard area is comprised of all closed landfills at PORTS and includes one potential waste disposal facility. As discussed above for the groundwater hazard area, while landfills are discussed as a major source to groundwater, landfills also present potential risk to receptors from soil and surface water and therefore must take into account different receptor and pathway scenarios. As a result, some information discussed in the groundwater and landfill hazard areas is duplicative; however, the reiteration of this information is warranted to substantiate the potential risk associated with each hazard area.

- Hazard Area 4 (Legacy Waste and DMSAs): This hazard area is comprised of legacy waste found at storage locations at PORTS and potentially contaminated materials found in DOE Material Storage Areas (DMSAs).

- Hazard Area 5 (Cylinder Yards): This hazard area is comprised of the cylinder yards that contain DUF_6 and a facility currently planned to convert the DUF_6 to more stable uranium oxides before off-site shipment.

- Hazard Area 6 (GDP Facilities): This hazard area is comprised of the GDP facilities and infrastructure that are anticipated to undergo future D&D activities.

- Hazard Area 7 (Surface Water Impoundments): This hazard area is comprised of each surface water impoundment throughout PORTS. It encompasses the impounded bodies of surface water found within the industrialized portion of PORTS, but does not include creeks and ditches, as these are discussed in a separate hazard area.

- Hazard Area 8 (Surface Water): This hazard area is comprised of surface water creeks and ditches. It encompasses the plant ditches and outfalls found inside the industrialized portion of PORTS and those that are found outside the industrialized area, which run both on and off DOE property.

Qualitative Barrier Failure Analysis: Probability of Failure and Consequence

Seven specific barriers and five processes that protect receptors from exposures at PORTS are presented throughout Chap. 4 and are depicted on the CSMs and hazard-specific maps. These barriers and processes are consistently numbered in both the text and figures throughout all hazard area discussions. Each of the barriers has a finite probability of failure and an associated generic consequence, should a barrier fail. A qualitative discussion of these potential failures and consequence of failure for each barrier is presented below. In some cases, there may be specific barrier failure consequences for a particular hazard area, which will be further discussed in the subsection relating to that hazard. Processes that are protecting receptors may not be subject to failure in the same manner as barriers but range in their effectiveness. The consequences of these differences in effectiveness for each process are also discussed below.

Access controls are considered a barrier and are labeled ① throughout this document. These are physical and procedural controls that protect workers from coming into contact with contaminants. These may be fencing, personal protective equipment, work rules/ procedures, work permits, signs or other controls. Access controls can sometimes fail. Individuals do ignore institutional control procedures or perform work ignorant of the existence of institutional controls. However the probability of such failure is low provided that DOE retains control of PORTS. Under normal circumstances, due to the stringent institutional control procedures, the only receptors to be impacted while access controls are in place are the ecological receptors and the intruder. In the event of access control failure, all receptors could be exposed. Since the scenarios for workers, recreational users, and other receptors have different parameters, their exposures, after barrier failure, could be considerably larger.

The circled numbers (e.g. "①") refer to barriers or processes labeled on the CSMs, Treatment Trains, and hazard-specific maps throughout this document.

Ground or soil cover is considered a barrier and is labeled ②. This includes pavement and vegetation (that reduces or eliminates the dispersal of contaminants such as dust), as well as layers of soil (that inhibit the transfer of volatiles to the open air and protect receptors from contacting contaminants). Failure of this barrier is possible if the vegetation or pavement is disturbed or if the pavement is allowed to deteriorate. Also, future workers could penetrate the soil barrier and excavate into areas currently protected by soil cover. The probability of this failure is considered low since DOE will be retaining control of the site for the foreseeable future and procedures such as work permits would be in place (barrier ①). Under normal circumstances, only intruders disturbing the groundcover and ecological receptors (i.e., vegetation) are exposed despite this barrier. In the event this barrier fails, workers, and visitors could be exposed to contaminants in the subsurface soil or to volatilized contaminants in the air. Ecological receptors could experience increase exposures in the event of barrier failure.

A deed notation filed with Pike County by DOE that prohibits the use of groundwater from the site or drilling into the groundwater without DOE's prior approval is a barrier and is labeled ③. Failure of this barrier is possible if DOE or another entity does not enforce the deed notation. The probability of this is considered low since DOE will be retaining control of the site for the foreseeable future. Under current conditions, no receptors except ecological (e.g., deep rooted vegetation) are exposed to contaminated groundwater. Failure of this barrier could result in the exposure of workers and other visitors to contaminated groundwater.

The groundwater pump and treat systems are considered a barrier and are labeled ④. This barrier includes pumping the building sumps of X-705 and X-700 in the 7-Unit groundwater plume, and the pump and treat systems in the areas of X-622, X-623 and X-624. Failure of this barrier is possible if the sumps and wells are no longer pumped. This would allow the migration of the current plumes. The probability of this is considered low since DOE will be retaining control of the site for the foreseeable future and intends to continue pumping and maintaining the systems for effective use. Under current conditions, no receptors are exposed to the contaminated groundwater. In the event this barrier fails, the plumes would eventually migrate and discharge to surface water. Ecological receptors and visitors (e.g., recreational users) could be exposed to contaminated surface water.

Two types of physical barriers to groundwater migration exist at PORTS and are labeled ⑤. These barriers include: a slurry wall that currently contains the X-749/X-120 plume and an interceptor trench collecting the groundwater from the X-701B plume before it seeps into Little Beaver Creek. Both barrier walls and trenches have a limited lifetime and so failure of these migration barriers is likely if they are not monitored and maintained. The probability of this is considered medium since DOE will be retaining control of the site for the foreseeable future and intends to monitor these barriers as long as they are needed. Maintenance of the interceptor trench is planned for the future and alternative mitigation measures will be taken should the slurry wall prove to be inadequate. Under current conditions, these barriers are preventing migration of contaminated groundwater offsite to the south (i.e., slurry wall) and to surface water to the east (i.e., interceptor trench). This prevents potential exposure of ecological and visitor receptors and offsite residents to contaminated groundwater or surface water. If these barriers were to fail, then ecological and visitor receptors and offsite residents could be exposed to contaminated groundwater or surface water.

The landfill caps that have been installed on all landfills at PORTS are barriers and are labeled ⑥, These barriers include leachate collections systems on some landfills. Failure of the caps and leachate collection systems to protect potential receptors is possible if they are not maintained and are not protected by access controls (i.e., barrier ①). The probability of failure is considered low since DOE will be retaining control of the site for the foreseeable future and intends to maintain and monitor the landfills for the foreseeable future. Under normal circumstances, only ecological receptors (e.g., deep rooted vegetation) and intruders (e.g., unauthorized breach of cap without proper work rules/procedures in place) are potentially exposed to contaminants from the landfills. If the barriers were to fail, then the ecological and visitor receptors could be exposed to contaminants in the landfills or in the leachate from the landfills. Workers would continue to be protected by access controls and work rules/procedures (i.e., barrier ①).

The buildings that house the DMSAs and legacy waste are considered barriers and are labeled ⑦. These barriers prevent any exposure to environmental media. Within the buildings, the waste is containerized, which further prevents environmental exposures. Failure of the containment provided by the buildings is possible if the buildings are not maintained. The probability of this failure is considered low since DOE will be retaining control of the site for the foreseeable future and intends to maintain and monitor the buildings. Under current conditions, no exposures exist. If these barriers were to fail, then the ecological and visitor receptors could be potentially exposed to contaminants if the waste containers also failed.

Monitoring of outfalls is considered a process and is labeled ⑧. This process is to ensure the timely discovery of contaminant releases so that measures could be implemented to mitigate any exposures. The probability of this process being discontinued is considered low since DOE will be retaining control of the site for the foreseeable future and intends to continue monitoring in accordance with existing NPDES permits. Under current conditions, the ecological and visitor receptors are potentially exposed to contaminants in surface water and surface water impoundments. If monitoring were to cease, the same receptors would be exposed, although there would be no method for determining the need for any mitigating measures.

Monitoring of groundwater is a process and is labeled ⑨. Currently, groundwater monitoring shows that no contaminated groundwater is moving off site. Under current conditions, only ecological receptors (e.g., deep rooted vegetation) are potentially exposed to contaminated groundwater. If monitoring were to cease, the same ecological receptors would be exposed, and there would be no method for determining whether mitigating measures were necessary, which could result in the eventual offsite migration of contaminated groundwater. If contaminated groundwater does migrate offsite, then offsite residents could be exposed.

The natural attenuation of surface water contaminants verified by monitoring of surface water is considered a process and is labeled ⑩. This process prevents significant exposures to contaminants in surface water. Under current conditions, ecological receptors are potentially exposed to contaminated surface water; however the exposure is minimized by this process. This process is expected to continue to protect not only ecological receptors but recreational users in future use scenarios.

Bio-phytoremediation is a process and is labeled ⑪. This process includes planting hybrid Poplar trees and injection of hydrogen releasing compounds and is being implemented or is planned for some of the groundwater plumes. The failure of this process to significantly reduce the source of contamination is possible. These technologies are currently under evaluation as to the amount of concentration reduction. Failure of these technologies would not impact the type of potential receptors exposed, but rather would impact the contaminant levels to which the receptors are exposed.

Source reduction is a process and is labeled ⑫. This process involves injection of oxidizers into groundwater plumes contaminated with organic chemicals. The failure of this process to significantly reduce the source of contamination is possible. This technology is currently under evaluation as to the amount of impact on source reduction of DNAPL concentrations. Failure of this technology would not impact the type of potential receptors exposed, but rather would impact the contaminant levels to which the receptors are exposed.

Risk Scenarios

There are three land use scenarios discussed in the following text: an industrial land use scenario, a commercial land use scenario, and a recreational land use scenario. The potential receptors in the CSMs and treatment trains are assumed to operate within these land use scenarios. The relevant differences between an industrial land use and a commercial land use are primarily in the types of activities anticipated to occur, rather than the cleanup levels. Both commercial and industrial land use scenarios are typically evaluated using an industrial worker risk scenario. Therefore the cleanup levels would be the same for both land use types.

Risk Balancing

In comparing the ES Vision and the current baseline end state, it is useful to discuss the relative risks in terms of short-term and long-term, as well as the risks to different receptors for each end state. This is discussed in the risk balancing section for each hazard area. A balancing of risk in this context does not mean that the risks are equivalent, but rather that they are the options (i.e., trade-offs) that need to be considered. The basic discussions are the relative magnitude of risk for the short-term, due to changes in remediation, and for the long-term, due to contaminants left in place or maintenance of barriers. In addition, for each hazard area the receptors potentially exposed depend on whether or what type of remediation is conducted or what maintenance is required for the long-term. The balance between the magnitude of risk to each receptor over the long-term and short-term is what is considered.

4.1 HAZARD AREA 1 (GROUNDWATER PLUMES AND SOURCES)

4.1.1 Sources and Contaminants of Concern

There are five groundwater contaminant plumes at PORTS, all of which are named in association with facilities and/or buildings believed to be their sources (discussed below). Each plume is known to exist in the Gallia sand and gravel formation, which is known to average between 16 to 18 feet below ground surface.

The *X-701B Plume* is centrally located in Quadrant II and covers roughly 22.5 acres. The X-701B groundwater plume is the most highly contaminated plume at PORTS, with concentrations of trichloroethene (TCE) detected as high as 490,000 µg/L. The rate of groundwater flow in this area during third quarter 2003 has been estimated to range from 0.1-0.6 ft/day.

The *X-740 Plume* is centrally located in Quadrant III and covers roughly four acres. The rate of groundwater flow in this area during third quarter 2003 has been estimated 0.2 ft/day.

The *Quadrant II 7-Unit Plume* is located in the western portion of Quadrant II and covers roughly 23.5 acres. The rate of groundwater flow in this area during third quarter 2003 has been estimated at 0.5 ft/day.

The *Quadrant I 5-Unit Plume* is located in the northern portion of Quadrant I and covers roughly 47.5 acres. The rate of groundwater flow in this area during third quarter 2003 has been estimated to range from 0.2-1.1 ft/day.

The *X-749/X-120 Plume* is located in the southern portion of Quadrant I and covers roughly 94.9 acres. The rate of groundwater flow in this area during third quarter 2003 has been estimated to range from 0.1-0.7 ft/day.

There are 11 areas that comprise the groundwater plumes and sources hazard area. These are areas where groundwater is monitored as part of the Integrated Groundwater Monitoring Plan, but are not necessarily contributing to one of the five groundwater plumes. Landfills are included in this hazard area as sources to groundwater only, as they are addressed in other aspects in the landfill-specific discussion in Sect. 4.3. The units that make up this hazard area include:

- X-611A Former Lime Sludge Lagoons,
- X-616 Chromium Sludge Surface Impoundments,
- X-633 Pump House Cooling Towers,
- X-701B Holding Pond
- X-734 Landfills (Closed),
- X-735 Landfill (Closed),
- X-749 Contaminated Materials Disposal Facility (Closed),
- X-749A Classified Materials Disposal Facility/Quadrant I Groundwater Investigative Area (Closed),
- X-749B/Peter Kiewit Landfill (and XT-847 Warehouse) (Closed),
- Quadrant II Groundwater Investigative Area, and
- X-740 Groundwater Investigative Area,

The *X-611A Former Lime Sludge Lagoons* consisted of three former lagoons that received sludge from the X-611 Water Treatment Facility and covered approximately 18 acres. Remediation of this unit, which involved transforming the lagoons into a prairie and wetland area, was completed in 1997. These lagoons are not definitively associated with a groundwater plume.

The *X-616 Liquid Effluent Control Facility* consisted of two unlined surface impoundments that were used from 1976 to 1985 for storage of sludge generated by the treatment of recirculating cooling water blowdown from the PORTS process cooling system. A hexavalent chromium-based corrosion inhibitor was used in the cooling water system. The chromium in the blowdown was reduced to trivalent chromium at the X-616 Liquid Effluent Control Facility by adding sulfur dioxide to the water, which produced sulfurous acid (H_2SO_3). The resulting chromium hydroxide sludge was then precipitated in a clarifier by pH adjustment with slaked lime and a polymer coagulant. The sludge was then pumped into and stored in the X-616 impoundments. The sludge was removed from the impoundments and remediated as an interim action in 1990 and 1991. This facility is not definitively associated with a groundwater plume.

The *X-633 Pumphouse/Cooling Towers Area* consists of a recirculating water pumphouse and four cooling towers (X-633-1, 2A, 2B, 2C, 2D) with associated basins. Chromium based corrosion inhibitors were added to the water until the early 1990's, when a switch to phosphate based inhibitors occurred. Copper arsenate is used in the cooling towers as a fungal growth inhibitor. This is a deferred unit that will be reevaluated annually, as discussed in Sect. 1.3.2. This facility is not definitively associated with a groundwater plume.

The *X-701B Holding Pond* was an unlined pond that originally drained into the East Drainage Ditch. The holding pond was used from the beginning of plant operations in 1954 until November 1988. The pond was designed for neutralization and settlement of acid waste from several sources, including the X-701C Neutralization Pit (which received waste solutions from the X-700 Chemical Cleaning Building), the X-705 Decontamination Building, and the X-720 Maintenance Building. Most wastes discharged to the X-701B Holding Pond were acid wastes, although degreasing solvents, primarily TCE with some trichloroethane (TCA), were also discharged to the pond. From February to May 1987, treated process effluent from the X-700 chemical cleaning facility, via the X-701C Neutralization Pit, was diverted to the X-616 Liquid Effluent Control Facility to reduce the high concentration of suspended solids discharged from the X-701B Holding Pond. In addition, chlorinated organic solvents were discovered in the X-700 Chemical Cleaning Facility basement sump that discharged to the X-701C Neutralization Pit. The X-700 and X-705 areas are deferred units that will be reevaluated annually, as discussed in Sect. 1.3.2.

What is DNAPL?

DNAPLs are liquid chemicals that do not readily dissolve in water and are denser than water. Once in the ground, DNAPLs can migrate downward through the subsurface, with a portion being trapped in the pore spaces in the soil and the remaining portion continuing to migrate downward.

In the subsurface, DNAPL serves as a continuing source of groundwater contamination as it slowly goes into solution with water. Because DNAPL is difficult to locate in the subsurface and often exists in the pore spaces in the soil, achieving DNAPL cleanup has been shown to be very difficult.

Current indications from the annual monitoring reports are that the X-701B plume may contain some dense non-aqueous phase liquid (DNAPL). However, these data are not full EPA level III data. Level III data meets higher standards for accuracy and precision as well as other quality standards. In the Quadrant RFI Reports and the CAS/CMS Reports, only Level III data was used for risk assessment and so no risk was attached to the very high concentrations of DNAPL. More recent work on PRG calculations for the X-701B area allow an estimate of risk, which is presented in Table 4.1 (SAIC 2003).

TCE is known to exist at concentrations presenting significant risk in the X-701B contaminated groundwater plume. The 2002 Annual Site Environmental Report (ASER) (DOE 2003i) shows concentrations at 490,000 μg/L of TCE in the X-701B plume.

The *X-734 Landfills* consisted of 2 landfills used until 1985. It is known that trash, construction debris, and empty drums were disposed there. Other materials possibly disposed of in this landfill include empty paint cans, uranium contaminated soils, fly ash, and waste contaminated with metals. The landfills were closed in accordance with the regulations at that time. They were capped in 1999-2000 as part of the Quadrant IV remedial actions. These landfills are not definitively associated with a groundwater plume but have the potential to contribute to groundwater contamination.

The *X-735 Landfill* is located in the northern portion of PORTS and began operation in September 1981. The unit was approved by Ohio EPA and the Pike County Department of Health for disposal of non-hazardous, non-radioactive solid wastes. The X-735 Landfill is divided into individual trenches that are referred to as cells. Solid wastes were delivered to X-735 in compactor trucks, pickup trucks, and dump trucks and were spread and compacted at the bottom of a cell in layers. Inadvertently, wipe rags potentially contaminated with solvents were disposed of in Cells 1 through 6 at the northern end of the landfill. At the end of 1991, waste disposal ceased in Cells 1 through 6, and Ohio EPA subsequently determined that these cells were to be closed as a RCRA hazardous waste landfill. Closure activities for the X-735 RCRA Landfill were completed in 1995, and included the installation of a RCRA Subtitle C cap. The southern portion of X-735 continued to operate as an industrial solid waste landfill (ISWL) until the end of 1997. Closure of the X-735 ISWL, which included the installation of a RCRA Subtitle D cap, was completed in 1998. This landfill is not definitively associated with a groundwater plume but has the potential to contribute to groundwater ocntamination.

The *X-740 Investigative Area* includes the X-740 Waste Oil Handling Facility, which was used from 1983 until 1991 as an inventory staging area for waste oil and solvents generated from plant activities. The facilities were closed under a closure approved by Ohio EPA in 1998. A remedial action which consists of a 2.6-acre grove of poplar trees has been installed over the groundwater plume in this area. The X-740 Waste Oil Handling Facility is not definitively associated with a groundwater plume.

The *X-749 Contaminated Materials Storage Yard* is located in the south central section of the facility. It includes a landfill that covers approximately 12 acres and was built in an area of highest elevation within the southern half of the facility. During operation of the landfill from 1955 through 1990, buried wastes were generally contained in metal drums or other containers that were compatible with the waste. The landfill was divided into a northern portion and southern portion. The northern portion is approximately 200,000 square feet (ft^2) in size and contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, and sludges that were classified as hazardous and low-level radioactive materials. The northern portion was closed in accordance with RCRA Subtitle C requirements. The southern portion is approximately 130,000 ft^2 and contains non-hazardous, low level, fixed, and possibly transferable radioactive scrap materials. The southern portion was closed in accordance with RCRA Subtitle D requirements. Because a groundwater contaminant plume underlies both portions, X-749 is considered a single unit for the purpose of groundwater monitoring. Closure of the X-749 Landfill was completed in 1992.

The *X-749A Classified Materials Disposal Area* is a 6-acre facility used until 1988 to dispose of materials classified under the Atomic Energy Act. The materials disposed included metallic process waste, building floor sweepings, computer media, GCEP scrap, and classified scrap materials. Closure of the landfill was completed in 1994 and included the installation of a multilayer cap and a surface water drainage system. This area is not definitively associated with a groundwater plume but has the potential to contribute to groundwater contamination.

The X-749B/*Peter Kiewit Landfill* was operated as a salvage yard, burn pit, and trash area during the construction of the PORTS facility. It was used as a sanitary landfill until 1968, at which point it was covered with soil and seeded with native grasses. A portion of the landfill may be overlain by the XT-847 warehouse. In 1998, the Peter Kiewit Landfill was capped in accordance with the Record of Decision issued by the Ohio EPA in July 1996 and U.S. EPA in May 1997 (DOE 2002).

The *Quadrant II Groundwater Investigative Area* consists of several potential sources and two groundwater plumes, the X-701B Holding Pond area (covered earlier in this section) and the 7-Unit area. Additional potential sources are the X-701C Neutralization Pit and the X-700 and X-705 Buildings. The pit was removed in 2001. Sumps in the basement of the X-700 and X-705 Buildings collect groundwater from the 7-Unit plume area and discharge it to the X-622T Groundwater Treatment Facility.

A wide variety of materials were disposed in the landfills including trash, garbage, construction debris, empty drums, solid wastes, wipe rags potentially contaminated with solvents, industrial solvents, waste oils from plant compressors and pumps, and sludges, that were classified as hazardous, low-level radioactive materials, non-hazardous, low level, radioactive scrap materials, and Atomic Energy Act materials. Other materials possibly disposed in the landfills include empty paint cans, uranium contaminated soils, and waste contaminated with metals. The landfills were also operated as a salvage yard, burn pit and trash area, as sanitary landfills, and two plots were managed with fertilizer and plowing to enhance the biological degradation of waste oil.

As described above, there are five contaminated groundwater plumes at PORTS. The Quadrant RFI reports indicate the concentration of contaminants driving risk in the soil areas of the plumes are: arsenic 58 mg/kg, chromium 5200 mg/kg and polycyclic aromatic hydrocarbons (PAHs) at 0.5 mg/kg. Within the groundwater the risk or hazard index (HI) driver concentrations are 0.11 milligrams per liter (mg/L) of arsenic for X-611A, 20 mg/L of vanadium for X-633, and 27 mg/L of chromium for the Quadrant II Groundwater Investigative Area. The 490,000 μg/l of TCE in the X-701B plume is a risk driver for that area. The primary contaminants driving risk at the X-749B Peter Kiewit Landfill are PCBs and arsenic with maximum concentrations of 0.007 mg/kg and 0.07 mg/kg, respectively. Other contaminants that drive risk at some of the other landfills are antimony (0.69 mg/kg) at X-749, arsenic (0.69 mg/kg and 38 mg/kg) for X-749B and X-734, respectively, beryllium (1.8 mg/kg) at X-734, and PAHs (5.7 mg/kg) at X-734.

4.1.2 Current State

As described above, remedial actions have been implemented for units listed in Sect. 1.3.2. Surveillance and maintenance, and groundwater monitoring are ongoing at all of the land based units. Five year performance reviews are required for the implemented land based remedies. All of these areas are part of the Integrated Groundwater Monitoring Plan for PORTS (DOE 2002b).

4.1.2.1 Media and pathways

The current state CSM (Fig. 4.1a2) identifies all five plumes in groundwater as being contaminated with VOCs. These contaminants are in solution and could migrate off the DOE property. However, the current data has shown no evidence of contaminated groundwater migrating offsite. Groundwater could be discharged to surface water. Once in surface water, contaminants could affect ecological receptors or enter the food chain. However, current data have shown no evidence of VOC contamination in surface water leaving the site.

Using the current state CSM (Fig. 4.1a2), the subsurface soil, groundwater, and surface water are of concern. Receptors potentially exposed to subsurface soil and groundwater are site workers. Receptors potentially exposed to surface water are site workers, visitors, and ecological receptors. In addition, offsite residents, visitors, and ecological receptors are potentially exposed through the food chain. Pathways considered for workers and visitors include ingestion, inhalation, dermal contact and direct exposure (radiation only). Ecological pathways vary depending on the type of organism, but include respiratory uptake, ingestion and dermal contact.

Barriers to exposure at the current state (Figs. 4.1a1 and 4.1a2) are continued access controls to prevent exposure to subsurface soil ①; approximately 10 feet of soil that covers the groundwater bearing zone ②; a deed notation that prohibits the use of groundwater ③; and pumping of the X-705 and X-700 basement sumps that discharge to the X-622T treatment plant, which is acting as a pump and treat system, as well as the pump and treat systems at X-622, X-623 and X-624 ④. Currently an interceptor trench ⑤ prevents groundwater from the X-701B plume from entering surface water, and a slurry wall contains the X-749/X-120 plume. Some plumes, such as the Quadrant II Groundwater Investigative Area, are contained by the X-701B interceptor trench and treated at the X-624 treatment facility. The landfills are covered with caps ⑥ that inhibit leaching of contents to groundwater and protect against direct contact and re-suspension of contaminants. Monitoring of groundwater indicates that currently no contaminated groundwater is leaving the site ⑨ and natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants. Bio-phytoremediation projects are ongoing at the X-749 and X-740 plumes ⑪. A number of sites have had tests of oxidant injection ⑫ for treatment of groundwater, including the X-701B and 5-unit plumes. More oxidant injection is planned for the X-701B plume.

The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS. Further details of the 1996 Ecological Risk Assessment (DOE 1996b) are discussed in Sect. 4.8.1.

4.1.2.2 Risk levels

Unmitigated risk levels at the groundwater plume locations for current and excavation workers range from below $1x10^{-6}$ to $4.6x10^{-3}$ (DOE 1995a,b,c,d, BJC 1995). These risks are calculated for a point of contact within each SWMU. Current use of this area is industrial. The primary source of risk is from metals, such as arsenic and chromium, and TCE. The risk levels and risk drivers are presented in Table 4.1 for all SWMUs by hazard area.

4.1.3 ES Vision

The ES Vision for this area is industrial with an industrial risk range of $1x10^{-4}$ to $1x10^{-6}$. There is no future use of the groundwater beneath PORTS, as it is restricted by deed notation filed with Pike County, and all water supplied to PORTS would continue to come from the well field located along the Scioto River. The point of compliance for groundwater would be the site boundary. Under the ES Vision, the current environmental monitoring, interceptor trenches, and well and sump pumping would continue along with the operation of the groundwater treatment facilities. This, along with the prohibition of groundwater use from the site, eliminates the risk from groundwater to industrial workers, who are the only receptors envisioned to be on the site. No transfer of contaminants to surface water would occur from the 7-unit plume. The current pumping of the sumps in the 7-unit plume area would continue;

however, the trees in the phytoremediation projects would not be replaced since they are not required to maintain the risk range.

4.1.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.1b2), the areas of concern and receptors are almost the same for the ES Vision as for the current baseline end state (Fig. 4.1c2). The difference between the two end states is the assumption of use of potable groundwater beneath the site in the current baseline end state. Under the ES Vision, the groundwater would continue to be restricted by the deed notation filed with Pike County.

Barriers to exposure under the ES Vision (Figs. 4.1b1 and 4.1b2) are continued access controls to prevent exposure to subsurface soil ①; approximately 10 feet of soil that covers the groundwater bearing zone ②; a deed notation that restricts the use of groundwater ③; and pumping of the X-700 and X-705 basement sumps that discharge to the X-622T treatment plant, which is acting as a pump and treat system, as well as the pump and treat systems at X-622, X-623 and X-624 ④. Currently, an interceptor trench ⑤ prevents groundwater from the X-701B plume from entering surface water, and a slurry wall contains the X-749/X-120 plume. Some plumes, such as the Quadrant II Groundwater Investigative Area, are contained by the X-701B interceptor trench and treated at the X-624 treatment facility. The landfills are covered with caps ⑥ that inhibit leaching of contents to groundwater and protect against direct contact and re-suspension of contaminants. Monitoring of groundwater would continue to ensure that no contaminated groundwater would leave the site ⑨ without appropriate mitigative measures, and natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants.

Under the ES Vision, potential receptors affected during implementation of the remedies (Fig. 4.1b3) are the environmental sampler, remediation worker, general site worker, disposal worker, transportation worker, and the public. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during completion of source actions (e.g., pump and treat). The general site worker could be exposed during implementation of the source actions. Transportation workers and the public could be exposed during the transportation of contaminated materials to a disposal facility. Ecologic receptors could be exposed during any remedial action.

4.1.3.2 Risk levels

Under the ES Vision, the projected risk would be *de minimis* for all receptors due to both the administrative procedures in place that restrict access, and to the barriers to groundwater migration and discharge to surface water, which would be maintained. The groundwater point of compliance would be the site boundary; therefore, groundwater risk would be calculated based on samples collected from the site boundary.

4.1.4 Current Baseline End State

The current baseline end state for this hazard area is industrial/commercial, with the assumption (based upon regulator direction) of the use of groundwater for drinking and showering by the industrial worker. (In actuality, groundwater has not been, and is not used in this manner, and any such use has been restricted by the deed notation filed with Pike County restricting groundwater use from beneath PORTS.) Regulators are requiring that the point of departure for risks to industrial workers and recreational users be at a risk level of 1×10^{-6} for their specified scenario and that the point of compliance would be within the body of each contaminant plume. The bio-phytoremediation projects would be continued as would the pump and treat system for the 7-unit plume.

4.1.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.1c2), the media and pathways are the same as for the current state discussed in Section 4.1.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

Barriers to exposure in the current baseline end state (Figs. 4.1c1 and 4.1c2) are continued access controls, such as excavation permits and PPE requirements, to prevent exposure to subsurface soil ① and continued deed notation preventing use of groundwater ③. The groundwater plumes at all locations would have treatment ④ or containment ⑤ in place. These treatments may include pump and treat action at the Quadrant II Groundwater Investigative Area, bio-phytoremediation projects, which are ongoing at the X-749/X-120 and X-740 contaminant plumes ⑪ and oxidant injection ⑫ at the X-701B plume. The landfills are covered with caps ⑥ that inhibit leaching of contents to groundwater and protect against direct contact and re-suspension of contaminants.

Under the current baseline end state, potential receptors affected during implementation of the remedies (Fig. 4.1c3) are the maintenance worker, environmental sampler, remediation worker, general site worker, transportation worker, disposal worker and the public. The maintenance worker could be exposed while maintaining the access restrictions and barriers. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during completion of source actions. The general site worker could be exposed during implementation of the source actions. The disposal worker could be exposed while accepting waste derived from implementing the source actions. Transportation workers and the public could be exposed during the transportation of contaminated materials to a disposal facility. Ecologic receptors could be exposed during any remedial action.

4.1.4.2 Risk levels

Under the current baseline end state, the projected risk would be *de minimis* for all receptors due to removal of the contaminated groundwater and to continuation of the access controls. The point of compliance for calculating risk from groundwater would be within the body of the contaminant plumes.

4.1.5 Risk Balancing

The ES Vision for the groundwater hazard area uses existing barriers to mitigate exposures. The current baseline end state would add a number of source reduction technologies to the existing barriers. The major differences would be in the long-term risk. Under the ES Vision, water treatment and other barriers would need to be maintained for the indefinite future to ensure that the mitigated risk remains *de minimis*. Under the current baseline end state, water treatment and other barriers could be allowed to deteriorate if source reduction activities are effective, which would indicate that the unmitigated risk had become *de minimis*. Activities to implement the source reductions required in the current baseline end state will present more short-term risk to ecological receptors than maintaining the current barriers; however, there will be a higher probability of future exposures to ecological receptors should the source reductions not be made. Both end states would be protective of human health and the environment.

4.2 HAZARD AREA 2 (SURFACE SOIL CONTAMINATION AND SOURCES)

4.2.1 Sources and Contaminants of Concern

There are a large number of SWMUs that have been identified as presenting a soils hazard to industrial workers, recreational visitors or excavation workers. The following table lists those areas that have risk levels for any non-residential exposure scenario above $1x10^{-6}$ or an HI value greater than 1.0 to any receptor in the appropriate Quadrant RFI Risk Assessments.

- X-342A – Feed Vaporization and Fluorine Generation Building,
- X-344D – Hydrofluoric Acid Neutralization Pit,
- Don Marquis Substation,
- X-5001 GCEP Substation,
- X-530A Switchyard,
- X-533A Switchyard,
- X-626 – Recirculating Cooling Water Pump House and Cooling Tower,
- X-630-1, -2, -3 – Recirculating Cooling Water Pump House, Cooling Tower, and Acid Handling Station,
- X-700 – Chemical Cleaning Facility,
- X-700/X-705 – Process Waste Lines,
- X-701 – Northeast Oil Biodegradation Plot,
- X-705A/X-705B – Incinerator and Contaminated Burnables Storage Lot,
- X-720 – Maintenance Building,
- X-744G – Bulk Storage Building,
- X-744N, P, Q – Warehouses and Associated Construction Headquarters Area, and
- X-747H – Northwest Surplus and Scrap Yard.

The historical uses of these areas include cooling water recirculation, storage and maintenance, incineration, and industrial processing.

The *X-342A Feed Vaporization and Fluorine Generation Building* is approximately 13,000 ft^2. Fluorine was generated by electrolysis at this unit.

The *X-344D Hydrofluoric Acid Neutralization Pit* is an open top concrete basin approximately 100 ft long by 4 ft deep with a trapezoidal cross section that is 29 ft wide at the top and 4 ft wide at the bottom. The pit is divided into four sections by concrete weirs and its total capacity is approximately 26,000 gallons. At one time, the pit was filled with crushed limestone to neutralize liquid hydrogen-fluoride in the event of a spill; however, because the limestone would have been ineffective for a major hydrogen-fluoride spill, it was removed to increase the capacity of the pit. The pit has been removed under a plan approved by Ohio EPA.

Of the switchyards included in the soil hazard area, only *X-530A and X-533A* remain as remediation targets, as the *Don Marquis Substation* has been identified as requiring no further action. Remediation for X-530A and X-533A has been deferred and will be addressed at the time of site D&D (Sect. 1.3.2). The X-5001 GCEP Substation was included in this hazard area since it is expected to continue operation for the advanced technology centrifuge deployment.

The *X-626 Recirculating Cooling Water Pump House and Cooling Tower* consisted of a number of structures and was used to remove waste heat from the gaseous diffusion process. The cooling water never came in contact with any process gases. Instead, heat was transferred first to freon and then to the cooling water through manifolds and condensers. Corrosion inhibitors, fungicide, microbicide and pH adjusters were added to the cooling water system. Chromium based corrosion inhibitors were used in the system until 1989, when it was changed to a phosphate-based inhibitor. Chlorine and sulfuric acid were added as microbicide and pH adjusters, respectively. Two fungicides, sodium pentachlorophenate and cupric arsenate, have been used to protect wood inside the cooling towers.

The *X-630-1 Recirculating Water Pump House, X-630-2 Cooling Towers, and X630-3 Acid Handling Station* constitute another of the cooling water systems. They consist of a 10,300 ft^2 building, two cooling towers, and two above ground sulfuric acid tanks, each with a 10,000 gallon capacity. There is also piping, which is used to fill the tank from either rail cars or trucks and to transfer the acid to either X-630 or to portable tanks for use elsewhere.

The *X-700 Chemical Cleaning Facility* has been used since 1955 for the cleaning and maintenance of non-radioactive and low level radioactive cascade equipment. The eastern half of the building is used to clean the cascade equipment while the western half houses a converter shop used to repair the cascade stages. The building is 200 ft by 520 ft and houses eight cleaning tanks, two vapor degreasers and a sand blast cabinet. The tanks range from 18,000 gallons to 24,000 gallons and extend 4 ft below ground level. Four tanks are concrete lined with acid proof brick and four are nickel plated steel. In addition, there is one 10,000 gallon steel storage tank and two 4,800 gallon spill containment tanks outside the building. The interior tanks, which are RCRA closed, have contained sodium bisulfite, alkali and rinse water, chromic acid and waste water contaminated with TCE and TCA. Other potential contaminants are nitric acid, sulfuric acid, sodium dichromate, sodium sulfate, sodium hydroxide, silver, and uranium.

The *X-700/X-705 Process Waste Lines* are duriron, clay and stainless steel used at PORTS until 1988. They transported effluent from X-700, X-705 and X-701C to the X-701B Holding Pond.

The *X-701 Northeast Oil Biodegradation Plot* consisted of two 400 ft by 20 ft plots which were used for the disposal of spent solvents, waste oil and sludge. The wastes were spread over the plots and disced or tilled on a monthly basis. After biodegradation was complete, the pH of the soil was adjusted and nitrogen fertilizer was applied. X-701 BP was closed under rules set by Ohio EPA and requires no further action.

The *X-705B – Contaminated Burnables Storage Lot* was associated with the *X-705A Incinerator*, which has been demolished. The lot is about 4,000 ft^2 and was used for the storage of paper, cardboard, sweepings, and rags contaminated with uranium and low-level radioactive solid waste. The storage lot consists of two concrete pads.

The *X-720 Maintenance Building* is a 281,200 ft^2 building use for maintenance, inspection and testing of process and auxiliary equipment. A neutralization pit spanning 51 ft^2 and 8 ft deep was located outside the building. The neutralization pit has been removed.

The *X-744G* is a bulk storage building. It is an 88,000 ft^2 building separated into two parts: one for restricted storage and one for unrestricted storage. It was used for storage of RCRA wastes and hazardous, mixed, and radioactive waste and has undergone RCRA closure. It is now used for interim storage of surplus uranium materials and low-level radioactive waste. After being certified closed in 1994, X-744G is being reused by DOE.

The *X-744N, P, Q Warehouses and Old Construction Headquarters* served as the contractor headquarters for Peter Kiewit Contractors, the original constructors of the Portsmouth GDP facilities.

Nearby areas were used for construction debris, parking, and for spreading of dewatered sludge from the X-2230N and X-2330M holding ponds.

The *X-747H Northwest Surplus and Scrap Yard* spans roughly a 32,800 yd^2 area that was used for the storage of low level radioactive metal scrap. The scrap was decontaminated before it was sent to the yard. The scrap metal surplus is being reduced in size and is being containerized and shipped off-site for disposal.

As could be expected with a number of SWMUs, there are a variety of contaminants in this hazard area including, beryllium, PAHs, uranium, VOCs, and chromium. Concentrations of these include 1,100 mg/kg of beryllium at X-626; 85 mg/kg of PAHs at X-747H; 8,400 pCi/kg of Uranium-238 at X-744G; 0.012 mg/kg of 1,1-dichloroethene; and 2,400 mg/kg of chromium at X-626. Risk levels for selected scenarios and concentrations are presented in Table 4.1.

All of the units included in this hazard area were evaluated and deemed to require no further action, were closed previously, or have had remediation deferred until D&D (Sect. 1.3.2). Thus, there is currently not enough information to estimate volumes and mass of contaminated soil.

The sources of the contaminants of concern vary. Arsenic was used in cooling water systems to inhibit fungi, and chromium was used as a corrosion inhibitor in the same systems. There were many transformers throughout PORTS that contained PCBs. PAHs are the result of combustion of petroleum as well as being derived from the tar and asphalt used as preservative in wood and on parking areas and roads. Also, since PORTS processed uranium, some uranium contamination is expected as a result of minor releases.

PORTS monitors fish from local streams and vegetation from soil sampling locations to determine whether there is any impact from certain contaminants on ecological receptors. The fish are monitored for PCBs, chromium and radiological parameters, and the vegetation is monitored for fluoride and radiological parameters. The 2002 ASER (DOE 2003i) reports that there was no impact to fish or vegetation determined from the parameters analyzed. The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS. Further details of the 1996 Ecological Risk Assessment (DOE 1996b) are discussed in Sect. 4.8.1.

4.2.2 Current State

Under the current state, the site is an industrial nuclear facility. The current facility is predominantly industrial with controlled access and is secured and patrolled.

4.2.2.1 Media and pathways

Using the current state CSM (Fig. 4.2a2), the waste and surface soil are of concern. Waste and contaminated surface soil are available onsite for direct contact. Receptors potentially exposed to waste material and soil are general site workers, visitors, and ecological receptors. In addition, the ecological receptor is potentially exposed through the food chain. Pathways considered for workers and visitors include ingestion, inhalation, dermal contact and direct exposure (radiation only). Ecological pathways vary depending on the type of organism but include respiratory uptake, ingestion and dermal contact.

The barriers to exposure and processes to reduce exposure at the current state (Figs. 4.2a1 and 4.2a2) are continued access controls to prevent exposure to waste and soil ①; vegetation and pavement on the contaminated soils to prevent resuspension of contaminants ②; and a deed notation that prohibits the use of groundwater ③. Monitoring of surface water outfalls will continue to ensure no contaminants are being released and to allow for mitigation if necessary ⑧. Monitoring of groundwater indicates that no contaminated groundwater currently is leaving the site ⑨ and natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants.

4.2.2.2 Risk levels

Unmitigated risk levels cited in the Quadrant RFI reports range from 3.0×10^{-6} at X-744 N,P,Q for an excavation worker to 1.7×10^{-2} for a future worker in the Berea at X-744G. The HIs are up to 114 for the future worker at X-744G. These risks are calculated for a point of contact within each SWMU. The risk levels and risk drivers are presented in Table 4.1 for all SWMUs by hazard area.

4.2.3 ES Vision

Under the ES Vision, the site would be predominantly industrial with some areas designated as open space/recreational or commercial land use with an industrial worker risk range of 1×10^{-4} to 1×10^{-6}. All work on the site is subject to comprehensive health and safety plans. The ES Vision also assumes that all water supplied to PORTS would continue to come from the current well fields located adjacent to the Scioto River, rather than from any onsite source. With current and planned nuclear activities in the industrial area continuing, through ongoing DOE and site missions, the site would continue to be controlled. Only limited recreational use of the site inside the DOE property boundary would be permitted. Intruders would be excluded from all areas within the Perimeter Road by the security fencing and access controls. Soil and waste removal under the ES Vision would be limited to hot spots outside Perimeter Road. Some of the units that are currently listed as deferred (X-342A, X-626-1/2, X-700) within this hazard area are presumed to already be at the ES Vision risk level. It is only necessary to maintain the current barriers to keep exposures at acceptable levels. Those deferred units that do not currently meet the ES Vision risk level (X-5001, X-530A, X-533A, X-630, X-700, X-705, X-705A/B, X-720, X-744N/P/Q, and X-747H) will require additional remediation to meet the industrial worker risk range of 1×10^{-4} to 1×10^{-6}.

4.2.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.2b2), the media and pathways are the same as for the current state discussed in Section 4.2.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the ES Vision.

The barriers to exposure and processes to reduce exposure at the ES Vision (see Figs. 4.2b1 and 4.2b2) are continued access controls to prevent exposure to waste and soil ①; vegetation and pavement on the contaminated soils prevent resuspension of contaminants ②; a deed notation that prohibits the use of groundwater ③; and some source removal. Monitoring of surface water outfalls would occur to ensure no contaminants are being released and to allow for mitigation if necessary ⑧; monitoring of groundwater would continue to ensure that no contaminated groundwater is leaving the site without appropriate mitigative measures ⑨; and natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants.

Under the ES Vision, receptors potentially exposed during implementation of the remedies (Fig. 4.2b3) are the general site worker, environmental sampler, remediation worker, and, if off-site disposal is required, the transportation worker, disposal worker, and the public. The general site worker could be exposed during excavation of soil and disposal of waste. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during soil excavation. The disposal worker could be exposed while accepting waste and soil. Finally, the transportation worker and the public could be exposed during transportation of waste to an off-site disposal location. Ecologic receptors could be exposed or disturbed during any remedial action.

4.2.3.2 Risk levels

At the ES Vision, projected risks to all potential receptors would be *de minimis* due to the barriers in place to prevent exposure or removal of source material. Risks would be calculated based on samples from within each SWMU for all media except groundwater. The groundwater point of compliance would be the site boundary; therefore, groundwater risk would be calculated based on samples collected from the site boundary. The risk target under the ES Vision is an industrial risk range of $1x10^{-4}$ to $1x10^{-6}$. The PCB concentration target is 25 parts per billion (ppb) based on TSCA standards.

4.2.4 Current Baseline End State

Under the current baseline end state, the site is an industrial nuclear facility and has some commercial operations. In addition, some areas of the site such as portions of creeks would be open to recreational use. It is envisioned that the land use within the Perimeter Road will remain industrial, with the land use outside Perimeter Road becoming commercial or open space/recreational. Regulators are requiring that the point of departure for risks to industrial workers and recreational users be at a risk level of $1x10^{-6}$ for their specified scenario. The industrial scenario includes a groundwater pathway for ingestion and showering.

4.2.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.2c2), the media and pathways are the same as for the current state discussed in Section 4.2.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

The barriers to exposure and processes to reduce exposure at the current baseline end state (Figs. 4.2c1 and 4.2c2) are continued access controls to prevent exposure to waste and soil ①; ground cover, which protects from contact and air dispersion ②; a deed notation that prohibits the use of groundwater ③; source removal; monitoring of effluents, which is ongoing to ensure that any future releases are identified quickly ⑧; and additional pump and treat remediation ④ to reduce the groundwater risk level to $1x10^{-6}$. Natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce the exposure to potential contaminants.

Under the current baseline end state, receptors potentially exposed during implementation of the remedies (Fig. 4.2c3) are the general site worker, environmental sampler, remediation worker, and, if off-site disposal is required, the transportation worker, disposal worker, and the public. The general site worker could be exposed during excavation of soil and disposal of waste. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during soil excavation. The disposal worker could be exposed while accepting waste and soil. Finally, the transportation worker and public could be exposed during transportation of waste to an off-site disposal location. Ecologic receptors could be exposed or disturbed during any remedial action.

4.2.4.2 Risk levels

Under the current baseline end state, projected risks to all potential receptors would be *de minimis* due to the barriers to prevent exposure and/or removal of source material. Risks would be calculated within each SWMU for all media. The groundwater point of compliance would be within the body of the contaminant plume. The PCB concentration target is 25 parts per billion (ppb) based on TSCA standards.

4.2.5 Risk Balancing

Many of the SWMUs within the soil hazard area have been deferred (except for X-344D, X-701, and X-744G) from further evaluation until D&D activities. Some of these are presumed to already be at their ES Vision risk level (Sect. 4.2.3). For those units that have been deferred but are not within the risk range (Sect. 4.2.3), further remediation would potentially expose remediation workers, transportation workers, disposal workers, ecological receptors and the public to increased short-term risk. With the assistance of access controls, the long-term exposures would be reduced from current levels to the *de minimis* levels cited in Sect. 4.2.2.2. Under the current baseline end state, all units would be reevaluated and potentially remediated. This would result in increased potential exposures to remediation workers, transportation workers, disposal workers, ecological receptors and the public. The eventual result, however, would be the *de minimis* risk levels cited in Sect. 4.2.3.2. In this case, the risk levels would be achieved without the assistance of access controls or other ongoing barriers. If, however, no additional remediation is conducted above the ES Vision levels, then low-level exposures, consistent with the acceptable risk range, would continue for ecological receptors and intruders. Site workers are protected by access controls and work rules/procedures so there would be no change in their potential exposures.

4.3 HAZARD AREA 3 (LANDFILLS)

4.3.1 Sources and Contaminants of Concern

The landfills at PORTS that make up this hazard area are:

- X-734A and B Construction Spoils Landfills (Closed)
- X-735 Landfills (Closed),
- X-749 Contaminated Materials Disposal Facility (Closed),
- X-749A Classified Materials Disposal Facility (Closed),
- X-749B Peter Kiewit Landfill (Closed), and
- X-231A and B Oil Biodegradation Plots (Closed).

These landfills have all been closed in accordance with applicable agreements and legal requirements and require no further action except monitoring, which is being conducted under the Integrated Groundwater Monitoring Plan and the Surveillance and Maintenance Plan. However, because these units were closed as landfills and their contents left in place, they contain materials that under some circumstances (e.g., intruder, ecological receptors) could pose a risk and which may be leaching to groundwater. It should be noted that the X-231A and B Oil Biodegradation Plots are not landfills but were included in this hazard area discussion because they are capped units.

A potential on-site waste disposal facility may be constructed at PORTS to contain the waste from D&D activities and legacy waste stored on site. The location of this facility has not been determined; however, it is expected to be located at one of three sites recommended for further evaluation in an initial siting study conducted in 2003 (BJC 2003a). The potential locations are shown on Figs. 4.3a1, 4.3b1 and 4.3c1.

The *X-734A and B Construction Spoils Landfills* consisted of two landfills used until 1985. It is known that trash, construction debris, and empty drums were disposed there. Other materials possibly disposed of in this landfill include empty paint cans, uranium contaminated soils, fly ash, and waste contaminated with metals. The landfills were closed in accordance with the regulations at that time. They were capped in 1999 and 2000 as part of the Quadrant IV remedial actions.

The *X-735 Landfill* is located in the northern portion of PORTS and began operation in 1981. The unit was approved by Ohio EPA and the Pike County Department of Health for disposal of non-hazardous, non-radioactive solid wastes. The X-735 Landfill is divided into individual trenches that are referred to as cells. Solid wastes were delivered to X-735 in compactor trucks, pickup trucks, and dump trucks and were spread and compacted at the bottom of each cell in layers. Inadvertently, wipe rags potentially contaminated with solvents were disposed of in Cells 1 through 6 at the northern end of the landfill. At the end of 1991, waste disposal ceased in Cells 1 through 6, and Ohio EPA subsequently determined that these cells were to be closed as a RCRA hazardous waste landfill. Closure activities for the X-735 RCRA Landfill were completed in 1995, and included the installation of a RCRA Subtitle C cap. The southern portion of X-735 continued to operate as an industrial solid waste landfill (ISWL) until the end of 1997. Closure of the X-735 ISWL, which included the installation of a RCRA Subtitle D cap, was completed in 1998.

The *X-749 Contaminated Materials Storage Yard* is located in the south central section of PORTS. It includes a landfill that covers approximately 12 acres and was built in an area of highest elevation within the southern half of the facility. During operation of the landfill from 1955 through 1990, buried wastes were generally contained in metal drums or other containers that were compatible with the waste. The landfill was divided into a northern and southern portion. The northern portion is approximately 200,000 ft^2 in size and contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, and sludges that were classified as hazardous and low-level radioactive materials. The northern portion was closed in accordance with RCRA Subtitle C requirements. The southern portion is approximately 130,000 ft^2 and contains non-hazardous, low level, fixed and possibly transferable radioactive scrap materials. The southern portion was closed in accordance with RCRA Subtitle D requirements. Because a groundwater contaminant plume underlies both portions, X-749 is considered a single unit for the purpose of groundwater monitoring. Closure of the X-749 Landfill was completed in 1992.

The *X-749A Classified Materials Disposal Area* is a 6-acre facility used until 1988 to dispose of materials classified under the Atomic Energy Act. Closure of the landfill was completed in 1994 and included the installation of a multilayer cap and a surface water drainage system.

The *X-749B/Peter Kiewit Landfill* was operated as a salvage yard, burn pit, and trash area during the construction of the PORTS facility. It was used as a sanitary landfill until 1968, at which point it was covered with soil and seeded with native grasses. In 1998, the X-749B/Peter Kiewit Landfill was capped in accordance with the Decision Document issued by the Ohio EPA in July 1996 and U.S. EPA in May 1997 (DOE 2002).

The *X-231A and X-231B Oil Biodegradation Plots* consisted of two plots, surrounded by berms, that were managed with fertilizer and plowing to enhance the biological degradation of waste oil. In 1997 as an interim remedial action (IRM) a clay cap and nitrile liner were installed over both plots. The purpose of the IRM was to prevent contaminant migration via surface water run-off and the infiltration of surface water. These two plots were declared Integrated Units in 1997 and will have a final decision on remediation determined by an Ohio EPA Director's Findings and Orders (DOE 1998).

As described above, a wide variety of materials were disposed in the landfills, including trash, garbage, construction debris, empty drums, solid wastes, wipe rags potentially contaminated with solvents, industrial solvents, waste oils from plant compressors and pumps, and sludges, that were classified as hazardous, low-level radioactive materials, non-hazardous, low level, radioactive scrap materials, and Atomic Energy Act materials. Other materials possibly disposed in the landfills include empty paint cans, uranium contaminated soils, and waste contaminated with metals. The landfills were also operated as a salvage yard, burn pit and trash area, as sanitary landfills, and two plots were managed with fertilizer and plowing to enhance the biological degradation of waste oil.

The primary contaminants driving risk at the X-749B Peter Kiewit Landfill are PCBs and arsenic with maximum concentrations of 0.007 mg/kg and 0.07 mg/kg, respectively. Other contaminants that drive risk at this and other landfills are antimony (0.69 mg/kg) at X-749B, arsenic (0.69 mg/kg and 38 mg/kg) for X-749B and X-734, respectively, beryllium (1.8 mg/kg) at X-734, PAHs (5.7 mg/kg) at X-734, and gamma chlordane (0.00133 mg/kg) at X-231A.

PORTS monitors fish from local streams and vegetation from soil sampling locations to determine whether there is any impact from certain contaminants on ecological receptors. The fish are monitored for PCBs, chromium, and radiological parameters, and the vegetation are monitored for fluoride and radiological parameters. The 2002 ASER (DOE 2003i) indicates that there were no impacts to fish or vegetation determined from the analyzed parameters. The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS. Further details of the 1996 Ecological Risk Assessment (DOE 1996b) are discussed in Sect. 4.8.1.

Mass and volume of the contaminants are not known for the landfills at PORTS due to a lack of historical records.

4.3.2 Current State

As discussed above, the landfills are all closed, and no activities are anticipated in the future except for the ongoing groundwater monitoring associated with the groundwater plumes and surveillance and maintenance of the landfill caps.

4.3.2.1 Media and pathways

The current state CSM (Fig. 4.3a2) identifies buried waste and soil as current sources of contamination. Contaminants from these sources may migrate to surface water; however, this is an uncertain pathway due to the presence of caps and leachate collection systems. Once in surface water, contaminants could affect ecological receptors or enter the food chain; however, this pathway is uncertain as well. Contaminants may also migrate to groundwater, as discussed in Sect. 4.1.

Using the current state CSM (Fig. 4.3a2), the buried waste, subsurface soil, groundwater and surface water are of concern. Receptors potentially exposed to waste and soil are general site workers, recreational visitors, and ecological receptors. Receptors potentially exposed to surface water are general site workers, recreational visitors, and ecological receptors. Receptors potentially exposed to groundwater are remediation workers. In addition, the recreational visitor and ecological receptor are potentially exposed through the food chain. Pathways considered for workers and visitors include ingestion, inhalation, dermal contact and direct exposure (radiation only). Ecological pathways vary depending on the type of organism, but include respiratory uptake, ingestion and, if available, dermal contact.

Barriers to exposure and processes to reduce exposure at the current state (Figs. 4.3a1 and 4.3a2) are access controls ①; a deed notation that prohibits the use of groundwater ③; pumping of groundwater in a pump and treat system ④ at X-622; a slurry wall ⑤ that contains the X-749/X-120 plume; and the landfill caps, leachate collection system, and monitoring ⑥, which minimize contaminant migration. In addition, monitoring of groundwater shows that currently no known contaminants are migrating off site ⑨; and natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants.

4.3.2.2 Risk levels

The unmitigated risks calculated for the PORTS RFI reports range from below $1x10^{-6}$ to $1.2x10^{-4}$ for current workers. These risks are based on the presence of arsenic, beryllium, PAHs and PCBs, as well as some pesticides in the landfills. There is also an HI value of 1.6 for the recreational visitor at the X-749B/Peter Kiewit landfill. These risks are calculated for a point of contact within each SWMU. The risk levels and risk drivers are presented in Table 4.1 for all SWMUs by hazard area.

4.3.3 ES Vision

Under the ES Vision, land use at the landfills would be industrial with restricted access and would have an industrial risk range of $1x10^{-4}$ to $1x10^{-6}$. All landfills at PORTS are currently capped and are maintained. The only risk under the ES Vision is to intruders who may excavate a portion of a landfill without proper PPE; to recreational users who may contact surface water from seeps; to remediation workers who may contact groundwater; and to ecological receptors ingesting surface water, or where roots or burrows may penetrate the caps. These are not likely scenarios, as DOE is expected to remain the property owner for the foreseeable future, access restrictions and maintenance of the caps would continue, and no activities to disturb the landfills would be permitted without appropriate precautions and actions. Monitoring would continue on all landfills and associated seeps to ensure that appropriate action is taken to mitigate any potential exposure. Under the ES vision, the point of compliance for groundwater from the landfills would be the site boundary.

A potential on-site waste disposal facility may be constructed at PORTS to contain the waste from D&D activities and legacy waste stored on site. The location of this facility has not been determined; however, it is expected to be located at one of three sites recommended for further evaluation in an initial siting study conducted in 2003 (BJC 2003a). The potential locations are shown on Figs. 4.3a1, 4.3b1 and 4.3c1. This waste disposal facility is only one of several waste disposal options that could be used to attain the ES Vision.

4.3.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.3b2), the media and pathways are the same as for the current state discussed in Section 4.3.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the ES Vision.

Barriers to exposure and processes to reduce exposure at the ES Vision essentially match those currently in place (Figs. 4.3b1 and 4.3b2.) and include access controls ①; the deed notation that prohibits the use of onsite groundwater ③; pumping of the groundwater at the X-622 ④; a slurry wall that is blocking the migration of the X-749/X-120 plume ⑤; and the landfill cap, leachate collection system, and monitoring ⑥, which minimizes contaminant migration. In addition, monitoring of groundwater would continue to ensure that no known contaminants are migrating off the site ⑨ without appropriate mitigation measures. The natural attenuation of surface water with verification by monitoring ⑩ would continue to eliminate exposure to contaminants discharged (i.e., seeps) from groundwater.

Under the ES Vision, potential receptors during remedial activities (Fig. 4.3b3) are the maintenance worker and environmental sampler. The maintenance worker could be exposed while maintaining the access controls and long term stewardship of landfill containment systems. The environmental sampler could be exposed during routine sampling activities. There are no risks to these receptors because of the implementation of an excavation permitting system and PPE requirements. Ecologic receptors could be exposed during any remedial action.

4.3.3.2 Risk levels

Under the ES Vision, the projected risk would be *de minimis* for all receptors due to access restrictions, caps, land cover and natural attenuation of contaminants in surface water. Risks would be calculated based on samples from within each SWMU for all media except groundwater. The groundwater point of compliance would be the site boundary; therefore, groundwater risk would be calculated based on samples collected from the site boundary.

4.3.4 Current Baseline End State

The current baseline end state for landfills is industrial with restricted access and is essentially identical to the current state. The media and pathways remain the same, as do the risk levels. Regulators are requiring that the point of departure for risks to industrial workers and recreational users be at a risk level of $1x10^{-6}$ for their specified scenario and that the point of compliance for groundwater be within the body of the contaminant plumes.

A potential on-site waste disposal facility may be constructed at PORTS to contain the waste from D&D activities and legacy waste stored on site. The potential locations are shown on Figs. 4.3a1, 4.3b1 and 4.3c1.

4.3.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.3c2), the media and pathways are the same as for the current state discussed in Section 4.3.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

Barriers to exposure and processes to reduce exposure at the current baseline end state essentially match those currently in place (Figs. 4.3b1 and 4.3b2.) and include access controls ①; the deed notation that prohibits the use of onsite groundwater ③; pumping of groundwater in a pump and treat system ④ at X-622; a slurry wall ⑤ that contains the X-749/X-120 plume; and the landfill cap, leachate collection system, and monitoring ⑥, which inhibit or identify contaminant migration. In addition, monitoring of groundwater would continue to ensure that no contaminated groundwater is leaving the site ⑨without appropriate mitigative measures and the natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure to contaminants discharged (i.e., seeps) from groundwater. Bio-phytoremediation projects are ongoing at the X-749/X-120 plume ⑪.

Under the current baseline end state, potential receptors during remedial activities (Fig. 4.3c3) are the maintenance worker and environmental sampler. The maintenance worker could be exposed while maintaining the access controls and long term stewardship of landfill containment systems. The environmental sampler could be exposed during routine sampling activities. There are no risks to these receptors because of the implementation of an excavation permitting system and PPE requirements. Ecologic receptors could be exposed during any remedial action.

4.3.4.2 Risk levels

Under the current baseline end state, the projected risk would be *de minimis* for all receptors due to the access restrictions, caps, land cover and natural attenuation of contaminants in surface water. Risks would be calculated within each SWMU for all media.

4.3.5 Risk Balancing

All of the landfills have been closed under the appropriate laws and regulations. There is no significant difference between the risk to receptors including ecological receptors for the two end states.

4.4 HAZARD AREA 4 (LEGACY WASTE AND DMSAs)

4.4.1 Sources and Contaminants of Concern

The DOE Material Storage Areas (DMSAs) and the legacy waste areas at PORTS are located within five facilities that include:

- X-326 Process Buildings,
- X-330 Process Buildings,
- X-333 Process Buildings,
- X-700 Chemical Cleaning Facility,
- X-7725 Recycle Assembly Building.

All of these facilities are located within the secured area inside Perimeter Road. The legacy waste includes elemental mercury, Technetium-99, TCE, metals, PCBs and some low levels of radioactivity. Existing risk assessments have not evaluated the risk from these specific hazards but have concentrated on contaminants contained in the soil and groundwater in the vicinity of the buildings housing the DMSA and legacy waste. All of the legacy waste is containerized and presents no hazard or risk if left alone in its current state. However, each of the facilities housing the DMSA and legacy waste has had further evaluation deferred until D&D.

4.4.2 Current State

The DMSAs and legacy wastes are left from when the plant was an operating DOE facility. Since PORTS is to become an industrial nuclear facility leased by DOE to other entities, this material is projected to be removed by 2009 as part of the baseline operations.

4.4.2.1 Media and pathways

The current state CSM (Fig. 4.4a2) shows stored waste is identified as the current source of contamination. Contaminants found in these locations are available for direct contact on site. All contaminants are contained within buildings and therefore do not affect other media.

Using the current state CSM (Fig. 4.4a2), the stored waste is of concern. Receptors potentially exposed to stored waste are general site workers. Pathways considered for workers include ingestion, inhalation, dermal contact and direct exposure (radiation only).

Under current conditions, the barriers to exposure (Figs. 4.4a1 and 4.4a2) are access restrictions ① to prevent access to the waste, and the materials are all contained within buildings or storage containers ⑦.

Although none of the contaminants in this hazard area are currently mobile, PORTS monitors fish from local streams and the vegetation from soil sampling locations to determine whether there is any impact from certain contaminants on ecological receptors. The fish are monitored for PCBs, chromium and radiological parameters and the vegetation are monitored for fluoride and radiological parameters. The 2002 ASER (DOE 2003i) reports that there were no impacts to fish or vegetation determined from the parameters analyzed. The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS. Further details of the 1996 Ecological Risk Assessment (DOE 1996b) are discussed in Sect. 4.8.1.

4.4.2.2 Risk levels

Existing risk assessments have not evaluated the risk from these specific hazards, but have concentrated on contaminants contained in the soil and groundwater in the vicinity of the buildings housing the DMSA and legacy waste. Since risk for DMSAs and legacy waste has not been evaluated, the risk levels and risk drivers for the soils and groundwater for the buildings that house the DMSAs and legacy waste are presented in Table 4.1 for all SWMUs by hazard area.

4.4.3 ES Vision

Under the ES Vision, the facilities holding the DMSAs and legacy waste would be decontaminated to an industrial risk range of 1×10^{-4} to 1×10^{-6} and either removed or reused. All legacy waste materials presenting a hazard are removed and disposed in an offsite licensed and controlled facility. Removal of the DMSA and legacy waste is in the current baseline plan for the next five years while the final disposition of the buildings is to be determined at the time of D&D. The DMSA and legacy waste would have to be removed prior to final D&D of the buildings.

4.4.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.4b2), the media and pathways are the same as for the current state discussed in Section 4.4.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the ES Vision.

No barriers to exposure are required under the ES Vision (Figs. 4.4b1 and 4.4b2) because all waste would be removed. No exposure pathways from DMSAs or legacy waste at the site would be complete.

Under the ES Vision, receptors potentially exposed during implementation of the remedies (Fig. 4.4b3) are the remediation worker, transportation worker, disposal worker, and the public, if off-site disposal is required. The remediation worker could be exposed during removal of the legacy waste and emptying of DMSAs. The disposal worker could be exposed while accepting waste. Finally, the transportation worker and public could be exposed during transportation of waste to an off-site disposal location. Ecologic receptors could be exposed during any remedial action.

4.4.3.2 Risk levels

Under the ES Vision, there would be no risk from DMSAs or legacy waste due to offsite disposal of the waste.

4.4.4 Current Baseline End State

The current baseline end state is the same as the ES Vision. Under the current baseline end state, the facilities holding the DMSAs and legacy waste would be decontaminated and removed or reused. Regulators are requiring that the point of departure for risks to industrial workers and recreational users be at a risk level of $1x10^{-6}$ for their specified scenario. All legacy waste materials presenting a hazard are removed and disposed in an offsite licensed and controlled facility.

4.4.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.4c2), the media and pathways are the same as for the current state discussed in Section 4.4.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

No barriers to exposure are required at the current baseline end state (Figs. 4.4c1 and 4.4c2) because all waste is removed. No exposure pathways from waste at the site would be complete.

Under the current baseline end state, receptors potentially exposed during implementation of the remedies (Fig. 4.4c3) are the remediation worker, and the transportation worker, disposal worker, and the public, if off-site disposal is required. The remediation worker could be exposed during removal of the legacy waste and emptying of DMSAs. The disposal worker could be exposed while accepting waste. Finally, the transportation worker and public could be exposed during transportation of waste to an off-site disposal location. Ecologic receptors could be exposed during any remedial action.

4.4.4.2 Risk levels

Under the current baseline end state, there would be no risk from DMSAs or legacy waste due to offsite disposal of waste.

4.4.5 Risk Balancing

The two potential end states for the DMSAs and legacy waste hazard area are very similar in that both envision that the waste will all be removed and the facilities decontaminated or reused to achieve the end state. All of the waste is planned to be removed within the next five years, and the facilities containing the waste demolished or reused within the timeframe of the ES vision. There is no significant difference in the risk to any receptor between the two end states. Both end states would be protective of human health and the environment.

4.5 HAZARD AREA 5 (CYLINDER YARDS AND DUF_6 CONVERSION FACILITY)

4.5.1 Sources and Contaminants of Concern

The cylinder yards include X-744, X-745A, X-745B/C/E/F/G/H. These areas are currently or were previously used for storing both empty cylinders and cylinders that contain DUF_6. The X-744 area has been used since 1955 to store both empty cylinders and cylinders containing low-level radioactive waste (i.e., DUF_6). Newer rectangular steel containers also containing low-level radioactive DUF_6 are also stored in this area. The X-745A area was used to store cylinders but has been inactive since 1979. Sampling results from this unit show that it is below risk-based concentration levels (BJC 2004). The X-745B/C/E/F areas are concrete pads that also are used to store DUF_6 cylinders. The cylinders are placed on cradles and double stacked for storage. The X-745G cylinder yard is a new, fenced, concrete yard outside Perimeter Road. This new yard is in the process of changing from USEC to DOE management. USEC has plans to construct the X-745H cylinder yard across a surface water ditch from X-745G. These areas are all shown on Fig. 4.5a1. The cylinder yards will be addressed at the time of site D&D (Sect. 1.3.2).

As discussed earlier, UDS will be building a facility to convert DUF_6 to a more stable form for long-term storage, use, or permanent disposal at an off-site location. The proposed site of the DUF_6 conversion facility is shown on Figs. 4.5a1, 4.5b1, and 4.5c1 in the northwest quadrant of the site. Conversion to oxide for use or long-term storage would begin as soon as possible, with conversion to metal only if uses for the metal are identified.

The primary risk drivers for these units are uranium (20,000 pCi/kg), PAHs (2 mg/kg), beryllium (2.4 mg/kg), and Arsenic (27 mg/kg).

4.5.2 Current State

The cylinder yards are currently in use for storage of full and empty DUF_6 cylinders as well as for low-level waste. It is expected that the use of these yards will continue until the DUF_6 is processed through the conversion facilities and dispositioned, as discussed above.

4.5.2.1 Media and pathways

The current state CSM (Fig. 4.5a2) shows the cylinders and associated soils are identified as sources of contamination. Contaminants found associated with the cylinders, and soil, are available for direct contact on site. Additionally, contaminants in surface soil could potentially migrate to surface water and sediment; however, this is an uncertain pathway. Once in the environment, contaminants could directly affect ecological receptors or enter the food chain.

Using the current state CSM (Fig. 4.5a2), the cylinders, soil, sediments, and surface water are of concern. Receptors potentially exposed to cylinders, and associated soil, are the general site worker and ecological receptors. Receptors potentially exposed to sediment and surface water are general site workers, visitors, and ecological receptors. In addition, the visitor and ecological receptor are potentially exposed through the food chain. Pathways considered for workers and visitors include ingestion, inhalation, dermal contact and direct exposure (radiation only). Ecological pathways vary depending on the type of organism, but include respiratory uptake, ingestion and, if available, dermal contact.

Under current conditions, the barriers to exposure and processes to reduce exposure (Figs. 4.5a1 and 4.5a2) are access restrictions ① to prevent access to the cylinder yards and planned DUF_6 conversion facility; vegetative cover and pavement ② that prevent significant re-suspension; and a deed notation that prohibits the use of groundwater ③. Monitoring of groundwater indicates that currently no contaminated groundwater is leaving the site ⑨ and natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants.

PORTS monitors fish from local streams and vegetation from soil sampling locations to determine whether there is any impact from certain contaminants on ecological receptors. The fish are monitored for PCBs, chromium and radiological parameters and the vegetation for fluoride and radiological parameters. The 2002 ASER (DOE 2003i) reports that there were no impacts to fish or vegetation determined from the parameters analyzed. The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS. Further details of the 1996 Ecological Risk Assessment (DOE 1996b) are discussed in Sect. 4.8.1.

4.5.2.2 Risk levels

The Quadrant RFI reports calculated an unmitigated maximum risk level of 4.0×10^{-4} due primarily to beryllium and arsenic at X-745C. Slightly lower risk levels were calculated based on the presence of

Uranium-235 and Uranium-238 at X-745B. These risks are calculated for a point of contact within each SWMU. The risk levels and risk drivers are presented in Table 4.1 for all SWMUs by hazard area.

4.5.3 ES Vision

Under the ES Vision, the DUF_6 conversion facility would have been constructed and it is anticipated that the DUF_6 cylinders currently in storage at PORTS and those cylinders currently being shipped to PORTS from East Tennessee Technology Park have been processed through the conversion facility. In the ES Vision, the site is an industrial/commercial facility with access inside Perimeter Road restricted to workers. The cylinder yards and conversion facility would have been decontaminated to an industrial risk range of 1×10^{-4} to 1×10^{-6} and either removed or reused. The cylinder yards and the conversion facility are within Perimeter Road and so would be cleaned to an industrial worker risk exposure range of 1×10^{-4} to 1×10^{-6}. Currently, all cylinder yards except X-745C are within the industrial risk range and are presumed to be at their ES Vision. However, since the cylinder yards, except for X-745A, are currently active, they will have to be reevaluated at the end of conversion facility operations. Some additional remediation may be necessary for X-745C and the other cylinder yards after operations cease.

4.5.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.5b2), the media and pathways are the same as for the current state discussed in Section 4.5.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the ES Vision.

Under the ES Vision, all sources of contamination would be removed. The other major barriers to exposure and processes to reduce exposure (Figs. 4.5b1 & 4.5b2) are access restrictions ① to prevent access to the cylinder yards and planned conversion facility; vegetative cover and pavement to prevent significant re-suspension ②; and a deed notation that prohibits the use of groundwater ③. Monitoring of groundwater would continue to ensure that no contaminated groundwater is leaving the site ⑨ without appropriate mitigative measures and natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants. Workers are, and will continue to be, protected from current risks by a comprehensive health and safety plan. The cylinder yards provide minimal habitat for ecological receptors, and the areas remain fenced and located within the secured perimeter of the facility.

Under the ES Vision, receptors potentially exposed during implementation of the remedies (Fig. 4.5b3) are the general site worker, environmental sampler, remediation worker, transportation worker, disposal worker, and the public, if off-site disposal is required. The general site worker could be exposed during D&D activities, excavation of soil, and disposal of waste. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during completion of D&D and soil excavation activities. The disposal worker could be exposed while accepting D&D waste and soil. Finally, the transportation worker and public could be exposed during transportation of waste to an off-site disposal location. Ecologic receptors could be exposed during any remedial action.

4.5.3.2 Risk levels

Under the ES Vision, the projected risk would be *de minimis* since all contaminants are removed to an industrial worker risk scenario. Risks would be calculated based on samples from within each SWMU for all media except groundwater. The groundwater point of compliance would be the site boundary; therefore, groundwater risk would be calculated based on samples collected from the site boundary.

4.5.4 Current Baseline End State

The current baseline end state for cylinder yards and DUF_6 conversion facility is the same as under the ES Vision.

4.5.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.5c2), the media and pathways are the same as for the current state discussed in Section 4.5.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

Under the current baseline end state, all sources of contamination would be removed. The other major barriers to exposure and processes to reduce exposure (Figs. 4.5c1 & 4.5c2) are access restrictions ① to prevent access to the cylinder yards and planned conversion facility; vegetative cover and pavement to prevent significant re-suspension ②; and the deed notation that prohibits the use of onsite groundwater ③. Monitoring of groundwater would continue to ensure that no contaminated groundwater is leaving the site ⑨ without appropriate mitigative measures, and natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants. Workers are, and will continue to be, protected from current risks by a comprehensive health and safety plan. The cylinder yards provide minimal habitat for ecological receptors, and the areas remain fenced within the secured perimeter of the facility.

Under the current baseline end state, receptors potentially exposed during implementation of the remedies (Fig. 4.5c3) are the general site worker, environmental sampler, remediation worker and the transportation worker, disposal worker, and the public, if off-site disposal is required. The general site worker could be exposed during D&D activities, excavation of soil, and disposal of waste. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during completion of D&D and soil excavation. The disposal worker could be exposed while accepting D&D waste and soil. Finally, the transportation worker and public could be exposed during transportation of waste to an off-site disposal location. Ecologic receptors could be exposed during any remedial action.

4.5.4.2 Risk levels

Under the current baseline end state, the projected risk to all users would be *de minimis* since all contaminants would be removed to maintain an industrial worker exposure level consistent with a risk in the $1x10^{-6}$ to $1x10^{-4}$ risk range. Risks would be calculated within each SWMU for all media.

4.5.5 Risk Balancing

The current baseline end state and the ES Vision for the Cylinder Yards hazard are very similar in that both envision that the facilities will be decontaminated or reused to achieve the end state. Since all of the units for this hazard area have been deferred (Sect. 1.3.2) or are not yet constructed (i.e., DUF_6 conversion facility), it is assumed that the cleanup goals, under the current baseline end state, will be the same as other cleanup goals already established in PORTS decision documents and will be the lower of either risk based or concentration based cleanup goals. The presumption is that deferred units, except for X-745C, are already at their ES Vision risk level (X-744, X-745A/B/E/F/G). There is a high probability that there will be more cleanup under the current baseline end state, which will result in more disruption to ecological communities and more potential short-term risks to remediation workers, transportation workers, disposal workers and the public. Under the ES Vision, there would be lower short-term impacts to ecological communities, and lower potential short-term risks for remediation workers, transportation workers, disposal workers and the public, and increased potential long-term risks to site workers and ecological receptors. Both end states would be protective of human health and the environment and risks would be *de minimis*.

4.6 HAZARD AREA 6 (GDP FACILITIES)

4.6.1 Sources and Contaminants of Concern

The GDP buildings included in the hazard area include:

- X-326 Process Building;
- X-330 Process Building;
- X-333 Process Building;
- X-710 Technical Services Building; and
- X-705 Decontamination Building.

The *X-326, X-330 and X-333 Process Buildings* are very large buildings spanning roughly 1,400,000 ft^2 each that contain diffusion cascade stages used for the gaseous diffusion process, which is currently in cold standby status. The X-705 Decontamination Building and X-710 Technical Services Building are much smaller than the process buildings. The *X-705 Decontamination Building* is a potential source of contamination to groundwater, which was detailed in Sect. 4.1; therefore X-705 will not be discussed here. The *X-710 Technical Services Building* is a 139,200 ft^2 building housing laboratories and facilities providing technical services to the overall PORTS operations. There was a neutralization pit and several underground storage tanks associated with the X-710 building. The X-326, X-330 and X-333 Process Buildings have equipment containing PCBs and may also contain radioactive wastes. All of the GDP facilities included in this hazard area with the exception of the X-710 and X-705 Buildings have been placed in a deferred status for remediation and will be addressed at the time of D&D (Sect. 1.3.2). The soils around the X-326 and X-330 Process Buildings already meet the ES Vision risk range; however, the soils associated with the X-333 do not meet the ES Vision and therefore may require further evaluation during D&D.

Risk drivers in these facilities are arsenic and antimony at 0.34 mg/L and 0.085 mg/L, respectively, for X-710, and PAHs at 180 mg/kg for X-333.

4.6.2 Current State

The GDP facilities and the immediate surroundings are industrial. They are part of the complex of buildings used in the gaseous diffusion process. It is currently envisioned that all of these buildings will be decontaminated, evaluated for reuse, or demolished.

4.6.2.1 Media and pathways

The current state CSM (Fig. 4.6a2) shows contaminated infrastructure and soils were identified as current sources of contamination. Contaminated infrastructure and soil are available for direct contact onsite. Contaminants in these media may migrate to groundwater and be transported to areas off DOE property. Additionally, contaminants may migrate to surface water and sediment and be transported to locations off DOE property. Finally, groundwater could be discharged to surface water. Once in surface water, contaminants could affect ecological receptors or enter the food chain.

Using the current state CSM (Fig. 4.6a2), the contaminated infrastructure, soil, groundwater, surface water, and sediments are of concern. Receptors potentially exposed to contaminated infrastructure and soil are general site workers, visitors, and ecological receptors. Receptors potentially exposed to groundwater are general site workers. Receptors potentially exposed to surface water are general site workers, visitors, and ecological receptors. In addition, the visitor and ecological receptor are potentially exposed through the food chain. Pathways considered for workers and visitors include ingestion, inhalation, dermal contact and direct exposure (radiation only). Ecological pathways vary depending on the type of organism, but include respiratory uptake, ingestion and dermal contact.

Barriers to exposure and processes to reduce exposure under the current state (Figs. 4.6a1 and 4.6a2) are access and excavation restrictions that prevent exposure to contaminants in soil ①, and the deed notation that prohibits the use of groundwater ③. Monitoring of groundwater indicates that currently no contaminated groundwater is leaving the site ⑨ and natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants. The GDP facilities and all associated contaminants, are within the secured perimeter of the site.

PORTS monitors fish from local streams and vegetation from soil sampling locations to determine whether there is any impact from certain contaminants on ecological receptors. The fish are monitored for PCBs, chromium and radiological parameters and the vegetation for fluoride and radiological parameters. The 2002 ASER (DOE 2003i) reports that there were no impacts to fish or vegetation determined from the parameters analyzed. The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS. Further details of the 1996 Ecological Risk Assessment (DOE 1996b) are discussed in Sect. 4.8.1.

4.6.2.2 Risk levels

According to the PORTS RFI report, the maximum unmitigated risk to current workers at any of three process buildings (X-326, X-330 and X-333) is calculated to be $1.7x10^{-3}$, due to 280 μg/L of arsenic in groundwater. In the vicinity of X-705, a future worker in the Berea would experience a risk of $3x10^{-3}$ with an HI of 17, due to 122 μg/L of arsenic. A future worker near X-710 would have a risk of $4x10^{-3}$ and an HI of 26.8 due to exposure to arsenic and antimony at concentrations of 340 μg/L and 85 μg/L respectively. These risks are calculated for a point of contact within each SWMU. The risk levels and risk drivers are presented in Table 4.1 for all SWMUs by Hazard area.

4.6.3 ES Vision

Under the ES Vision, the site is an industrial/commercial facility with access inside Perimeter Road restricted to workers. The GDP facilities and the immediate surrounding area would be decontaminated to an industrial risk range of $1x10^{-4}$ to $1x10^{-6}$, evaluated for reuse, or demolished. Since the facilities are within Perimeter Road they would be remediated to an industrial worker risk level. Those restrictions and work rules ensure the site can maintain an industrial worker exposure level consistent with a risk in the $1x10^{-6}$ to $1x10^{-4}$ risk range. The X-326 and X-330 Process Buildings are presumed to already be at their ES Vision. Note that groundwater contamination exists in the areas of the X-326 and X-330 Process Buildings; however, these buildings have been shown not to be sources of groundwater contamination. Remediation would be needed to bring X-705, X-710 and X-333 to the $1x10^{-4}$ to $1x10^{-6}$ industrial risk range.

4.6.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.6b2), the media and pathways are the same as for the current state discussed in Section 4.6.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the ES Vision.

Barriers to exposure and processes to reduce exposure under the ES Vision (Figs. 4.6b1 and 4.6b2) are continued access and excavation restrictions, which prevents exposure to contaminants in soil ①, and the deed notation that prohibits the use of groundwater ③. Monitoring of groundwater would continue to ensure that no contaminated groundwater is leaving the site ⑨ without appropriate mitigative measures, and natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants. Source removal actions are planned under the ES Vision that include decontamination of the buildings with disposal.

Under the ES Vision, receptors potentially exposed during implementation of the remedies (Fig. 4.6b3) are the general site worker, environmental sampler, remediation worker, transportation worker, disposal worker, and the public, if off-site disposal is required. The general site worker could be exposed during D&D activities, excavation of soil, and disposal of waste. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during completion of D&D activities and soil excavation. The disposal worker could be exposed while accepting decontamination waste and soil. Finally, the transportation worker and public could be exposed during transportation of waste to an off-site disposal location. Ecologic receptors could be exposed during any remedial action.

4.6.3.2 Risk levels

Under the ES Vision, projected risk levels for an industrial worker would be *de minimis* since the buildings have been decontaminated and removed. Risks would be calculated based on samples from within each SWMU for all media except groundwater. The groundwater point of compliance would be the site boundary; therefore, groundwater risk would be calculated based on samples collected from the site boundary.

4.6.4 Current Baseline End State

Under the current baseline end state, the site is an industrial/commercial facility with access inside Perimeter Road restricted to workers. Regulators are requiring that the point of departure for risks to industrial workers and recreational users be at a risk level of $1x10^{-6}$ for their specified scenario. The remediation work would be designed to maintain an industrial worker exposure level consistent with a risk in the $1x10^{-6}$ to $1x10^{-4}$ risk range.

4.6.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.6c2), the media and pathways are the same as for the current state discussed in Section 4.6.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

Barriers to exposure and processes to reduce exposure at the current baseline end state (Figs. 4.6c1 and 4.6c2) are continued access restrictions ①, which prevent exposure to contaminants in soil and the deed notation that prohibits the use of onsite groundwater ③. Monitoring of groundwater would continue to ensure that that no contaminated groundwater is leaving the site ⑨ without appropriate mitigative measures, and natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants. Source removal actions are planned under the current baseline end state and include D&D of buildings with disposal.

Under the current baseline end state, receptors potentially exposed during implementation of the remedies (Fig. 4.6c3) are the general site worker, environmental sampler, remediation worker, transportation worker, disposal worker, and the public, if off-site disposal is required. The general site worker could be exposed during D&D, excavation of soil, and disposal of waste. The environmental sampler could be exposed during sampling activities. The remediation worker could be exposed during completion of D&D, soil excavation, and source actions to address groundwater contamination. The disposal worker could be exposed while accepting D&D waste, soil, and other waste derived when implementing the source removal actions for groundwater. Finally, the transportation worker and public could be exposed during transportation of waste to an off-site disposal location. All of these exposures would be mitigated by comprehensive health and safety plans including PPE requirements for working with contaminated media. Ecological receptors could be exposed during any remedial action.

4.6.4.2 Risk levels

Under the current baseline end state, projected risk levels for an industrial worker would be *de minimis* since the buildings have been decontaminated and removed. Risks would be calculated within each SWMU for all media.

4.6.5 Risk Balancing

The current baseline end state and the ES Vision for the GDP facilities hazard area are very similar in that both envision that the facilities will be decontaminated, evaluated for reuse, or demolished to achieve the end state. Since four of the GDP facilities have been deferred (X-326, X-330, X-333, and X-705 soils), it is assumed that the cleanup goals, under the current baseline end state, will be the same as other cleanup goals already established in PORTS decision documents and will be the lower of either risk based or concentration based cleanup goals. It is presumed that X-326 and X-330 are already at their ES Vision risk level since they have a risk range of $1x10^{-4}$ to $1x10^{-6}$ and an HI of less than 1. Since further remediation is necessary for X-333, remediation workers, transportation workers, disposal workers and general site workers, as well as ecological receptors and the public, will experience short-term increases in risk levels. The X-710 is expected to remain as support facilities for the foreseeable future and is presumed that when operations cease, the cleanup goals will be the same as other cleanup goals already established in PORTS decision documents. If additional remediation is necessary to meet the goals of the current baseline end state, then remediation workers, transportation workers, disposal workers, and general site workers, as well as ecological receptors and the public, will experience increased risks. Both end states would be protective of human health and the environment.

4.7 HAZARD AREA 7 (SURFACE WATER IMPOUNDMENTS)

4.7.1 Sources and Contaminants of Concern

There are a number of surface water impoundments at PORTS:

- Chemical and Petroleum Containment basins (CPCB),
- X-2230M Southwest Holding Pond,
- X-2230N West Holding Pond No.2,
- X-230K South Holding Pond,

- X-230J3 West Environmental Sampling Building and Intermittent Containment Basin,
- X-230J5 West Holding Pond and Oil Separation Basin,
- X-230J6 Northeast Holding Pond,
- X-230J7 East Holding Pond and Oil Separation Basin,
- X-230L North Holding Pond, and
- X-701B Holding Pond.

All of these surface water impoundments except X-701B have been placed in a deferred status for remediation and will be addressed at the time of site D&D (Sect. 1.3.2). Of these deferred units, CPCB, X-2230M, X-2230N, and X-230J7 all meet the risk range of 1x10-4 to 1x10-6 and so are presumed to be at their ES Vision. The remainder of the surface water impoundments (X-230K, X-230J3, X-230J5, X-230J6, X-230L) will need additional remediation to achieve the ES Vision.

The *Chemical and Petroleum Containment Basins* were designed to collect spills during rail car unloading or storage operations. There are five basins located beneath the railroad tracks east of Building X-533C. The basins are roughly 10 ft by 18.5 ft and 4 inches deep and drain to three 4,800 gallon underground tanks.

The *X-2230M Southwest Holding Pond* was constructed in 1978 to help control runoff and sedimentation resulting from GCEP construction activities. It is approximately 1.1 acres in size and receives effluent from the ‘N’ and ‘O’ storm sewers.

The *X-2230N West Holding Pond No.2* is a pond similar to X-2230M, which controlled runoff from the northern half of the former GCEP construction site.

The *X-230K South Holding Pond and Sludge Pile* was constructed in 1956 to control sedimentation and runoff from storm sewers ‘F’, ‘G’ and ‘H’. The pond is irregular in shape and spans roughly 900 ft by 300 ft at its widest and is roughly 15 ft deep. It is monitored as NPDES Outfall 002.

The *X-230J3 West Environmental Sampling Building and Intermittent Containment Basin* is a small 150 ft^2 building that houses monitoring equipment and controls for gates of the containment basin. The gates can be closed to impound flow of the West Drainage Ditch under Perimeter Road. The basin receives flow from storm sewers ‘A’ and ‘B’.

The *X-230J5 West Holding Pond and Oil Separation Basin* is roughly ½ acre in size and was constructed to control sedimentation and storm water runoff from the north and central branches of the West Drainage Ditch and once-through cooling water from the process area air conditioning system. An oil skimming boom across the holding pond directs floating debris or oil to an adjacent secondary oil separation basin.

The *X-230J6 Northeast Holding Pond* consists of a pond, monitoring facility and secondary oil collection basin. The pond spans roughly 5,300 ft^2 and receives effluent form storm sewer ‘L’. The pond discharges to the northeast drainage ditch which in turn discharges to Little Beaver Creek.

The *X-230J7 East Holding Pond and Oil Separation Basin* were constructed in 1981 to control sedimentation and storm water runoff from the east side of PORTS.

The *X-230L North Holding Pond* is located on the north side of the plant and has an operating capacity of 390,000 gallons under normal conditions. In emergency conditions, it may have a capacity of

1,570,000 gallons and cover 34,000 ft^2. The pond is sampled weekly and is discharged into the North Drainage Ditch and then into Little Beaver Creek.

The *X-701B Holding Pond* was discussed in the hazard area 1 (Sect. 4.1) and therefore will not be reiterated here.

In the surface water impoundments, the primary contaminants that present a risk are arsenic at up to 100 mg/kg at X-230J6; antimony at 16 mg/kg at X-230J5; PAHs at up to 720 mg/kg at X-2230M; PCBs at 1.2 mg/kg; and beryllium at 0.79 mg/kg at X-2230N.

PORTS monitors fish from local streams and vegetation from soil sampling locations to determine whether there is any impact from certain contaminants on ecological receptors. The fish are monitored for PCBs, chromium and radiological parameters and the vegetation is monitored for fluoride and radiological parameters. The 2002 ASER reports that there were no impacts to fish or vegetation determined from the parameters analyzed. The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS. Further details of the 1996 Ecological Risk Assessment (DOE 1996b) are discussed in Sect. 4.8.1.

4.7.2 Current State

All of the surface water impoundments are either directly sampled as NPDES outfalls or indirectly monitored through a downstream sampling location (e.g., X-230J3).

4.7.2.1 Media and pathways

The current state CSM (Fig. 4.7a2) shows sediment from past enrichment operations are identified as current sources of contamination. Contaminants found in either media are available for direct contact on site or for transport to areas outside the industrialized area of PORTS. Once in the environment, contaminants could directly affect ecological receptors or enter the food chain.

Using the current state CSM (Fig. 4.7a2), the source material, sediments, and surface water are of concern. Receptors potentially exposed to source material are general site workers, visitors, and ecological receptors. Receptors potentially exposed to sediment and surface water are also general site workers, visitors, and ecological receptors. The visitor and ecological receptor are potentially exposed through the food chain. Pathways considered for workers and visitors include ingestion, inhalation, dermal contact, and direct exposure (radiation only). Ecological pathways vary depending on the type of organism, but include respiratory uptake, ingestion and dermal contact.

Under current conditions, the barriers to exposure and processes to reduce exposure (Figs. 4.7a1 and 4.7a2) are access controls to prevent exposure to source material ① and the deed notation that prohibits the use of groundwater ③. In addition, monitoring of effluents is ongoing to ensure that any future releases are identified quickly ⑧. Natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants.

4.7.2.2 Risk levels

Unmitigated risk from the surface water impoundments ranges from less than $1x10^{-6}$ to $4.4x10^{-3}$ at X-230K for the future worker exposed to groundwater in the Berea. The primary risk drivers are metals (e.g., chromium and arsenic), PAHs, PCBs and nitrobenzene at X-230J3. The HI ranges from less than 1 to 57 for an excavation worker at the X-230J3 impoundment. These risks are calculated for a point of contact within each SWMU. The risk levels and risk drivers are presented in Table 4.1 for all SWMUs by hazard area.

4.7.3 ES Vision

Under the ES Vision, the site is an industrial/commercial facility with access inside Perimeter Road restricted to workers and an industrial risk range of $1x10^{-4}$ to $1x10^{-6}$. The surface water impoundments would continue to be monitored and may be fenced to limit the possible exposure of recreational users of the site. Source removal actions in several hazard areas would be relied upon to eliminate the continued release of contaminants to the surface water impoundments. In addition, upon completion of D&D activities, the surface water impoundments would, if necessary, be cleaned of contaminated sediments. This work would be designed to maintain an industrial worker exposure level within a risk range of $1x10^{-4}$ to $1x10^{-6}$.

4.7.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.7b2), the media and pathways are the same as for the current state discussed in Section 4.7.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the ES Vision.

The barriers to exposure and processes to reduce exposure under the ES Vision (Figs. 4.7b1 and 4.7b2) are access controls to prevent exposure to source material ① and continuation of the current deed notation that prohibits the use of groundwater ③. In addition, monitoring of effluents is ongoing to ensure that any future releases would be identified quickly and appropriate actions are taken ⑧. Natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants.

Under the ES Vision, potential receptors during implementation of the remedies (Fig. 4.7b3) are the maintenance worker, environmental sampler, remediation worker, general site worker, transportation worker, disposal worker and the public. The maintenance worker could be exposed during the maintenance of access controls. The environmental sampler could be exposed during sampling activities. The remediation worker and general site worker could be exposed during implementation of the source actions. The transportation worker and public could be exposed during transportation of the waste to an offsite disposal facility. The disposal worker could be exposed during the disposal of the waste at the offsite facility. Ecologic receptors could be exposed during any remedial action.

4.7.3.2 Risk levels

Under the ES Vision, projected risks to all potential receptors would be *de minimis* due to the presence of barriers that prevent exposure and to source removal. Risks would be calculated based on samples from within each SWMU for all media except groundwater. The groundwater point of compliance would be the site boundary; therefore, groundwater risk would be calculated based on samples collected from the site boundary.

4.7.4 Current Baseline End State

For this hazard area, the current baseline end state is the same as the ES Vision. In the current baseline end state, the site is an industrial/commercial facility with access inside Perimeter Road restricted to workers. Regulators are requiring that the point of departure for risks to industrial workers and recreational users be at a risk level of $1x10^{-6}$ for their specified scenario. The surface water impoundments would continue to be monitored and may be fenced to limit the possible exposure of recreational users of the site. Source removal actions in areas not a part of the hazard area would be relied on to eliminate the continued release of contaminants to the surface water impoundments. In addition, upon completion of D&D activities, the surface water impoundments would be evaluated and, if necessary, cleaned of contaminated sediments.

4.7.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.7c2), the media and pathways are the same as for the current state discussed in Section 4.7.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

The barriers to exposure and processes to reduce exposure at the current baseline end state (Figs. 4.7c1 and 4.7c2) are access controls to prevent exposure to source material ① and continuation of the current deed notation that prohibits the use of groundwater ③. In addition, monitoring of effluents is ongoing to ensure that any future releases are identified quickly ⑧ and appropriate actions are taken. Natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants.

Under the current baseline end state, potential receptors during implementation of the remedies (Fig. 4.7c3) are the maintenance worker, environmental sampler, remediation worker, general site worker, transportation worker, disposal worker and the public. The maintenance worker could be exposed during the maintenance of access controls. The environmental sampler could be exposed during sampling activities. The remediation worker and general site worker could be exposed during implementation of the source removal actions. The transportation worker and public could be exposed during transportation of the waste to an offsite disposal facility. The disposal worker could be exposed during the disposal of the waste at the offsite facility. Ecologic receptors could be exposed during any remedial action.

4.7.4.2 Risk levels

Under the current baseline end state, projected risks to all potential receptors would be *de minimis* due to the presence of barriers that prevent exposure and source removal. Risks would be calculated within each SWMU for all media.

4.7.5 Risk Balancing

The two potential end states for the surface water impoundments hazard are very similar in that both envision there will be some contaminated sediment removal to achieve the end state. Since all the units have been deferred, it is assumed that the cleanup goals, under the current baseline end state, will be the same as other cleanup goals already established in PORTS decision documents and will be the lower of either risk based or concentration based cleanup goals. It is presumed that four of the deferred units (CPCB, X-2230M, X-2230N, X-230J7) are already at their ES Vision risk level since they are within the $1x10^{-4}$ to $1x10^{-6}$ industrial risk range. The difference in presumption between the two end states provides a difference in the risk levels to receptors resulting from the volume of the removals. For the current baseline end state, there will be higher potential short-term risk levels for remediation workers, transportation workers, disposal workers and the public. Under the ES Vision, the short-term risks would be lower for these same workers, and the potential long-term risk to site workers, ecological receptors, and recreational visitors would be higher. However, in both cases, the end state is protective of human health and the environment, and risk levels would be *de minimis*.

4.8 HAZARD AREA 8 (SURFACE WATER)

4.8.1 Sources and Contaminants of Concern

There are a number of surface water creeks and ditches at PORTS that comprise this hazard area:

- Little Beaver Creek,
- Big Run Creek,
- East Drainage Ditch,
- North Drainage Ditch,
- Northeast Drainage Ditch, and
- West Drainage Ditch.

All of these surface water bodies have been placed in a deferred status for remediation and will be addressed at the time of site D&D (Sect. 1.3.2). However, both Big Run Creek and the East Drainage Ditch currently meet the $1x10^{-4}$ to $1x10^{-6}$ risk range for industrial workers and are presumed to be at their ES Vision. The remainder of the units (Little Beaver Creek, North Drainage Ditch, Northeast Drainage Ditch, and West Drainage Ditch) may need additional remediation to meet the ES Vision. Some remediation of these units has been conducted since the risk assessments were completed, but re-evaluation would have to occur.

Little Beaver Creek runs onto DOE property on the east side and then flows northwesterly until exiting the property on the northwest side where it then flows into Big Beaver Creek to the west of the plant.

Big Run Creek originates at the X-230K South Holding Pond and flows south until it exits DOE property. The creek drains the entire southern portion of the DOE property through smaller ditches and the storm sewers.

The East Drainage Ditch was constructed in 1954 and originates south of the X-633 cooling towers. It flows eastward through X-230J7 and on into Little Beaver Creek. The East Drainage Ditch has received effluent from the X-701B Holding Pond as well as Storm Sewers ‘D’ and ‘E’.

The *North Drainage Ditch* consists of six small drainage ditches. These ditches receive discharges from Storm Sewers ‘C’, ‘K’, and ‘M’, as well as from the X-611 Supply Water Treatment Plant. The North Drainage Ditch discharges into Little Beaver Creek.

The *Northeast Drainage Ditch* receives effluent from Storm Sewer ‘L’ and receives plant runoff that collects in the X-230J6 Northeast Holding Pond where it than discharges to Little Beaver Creek.

The *West Drainage Ditch* is located on the west side of the DOE property and consists of four small drainage ditches that receive discharges from Storm Sewers ‘A’ and ‘B’. Two of the smaller ditches flow into X-230J3, continues on to X-230J5, and then on to the West Drainage Ditch proper. Another of the smaller ditches receives discharges from Storm Sewer ‘J’ before flowing into the X-2230N West Holding Pond, where it then flows on into the West Drainage Ditch proper.

In 1996 DOE performed a site investigation for radiological contamination along the West, North and Northeast drainage ditches at PORTS. The survey was performed using a 2-D High Purity Germanium Detector Gamma Spectroscopy to identify "hot spot" locations within the ditches. Hot spots detected were remediated by removal of the contaminated soils from the identified areas.

The primary risk drivers within the ditches and creeks are metals such as chromium (2,100 mg/kg) at the Northeast Drainage Ditch; arsenic (390 mg/kg) at the Northeast Drainage Ditch; PAHs (3.3 mg/kg) at the North Drainage ditch; and PCBs (2 mg/kg) at the East drainage ditch).

PORTS monitors fish from local streams to determine whether there is any impact from certain contaminants on ecological receptors. The fish are monitored for PCBs, chromium, and radiological parameters and the vegetation are monitored for fluoride and radiological parameters. The 2002 ASER reports that there were no impacts to fish or vegetation determined from the parameters analyzed. The 1997 Ohio EPA Biological and Water Quality Study of Little Beaver Creek and Big Beaver Creek (Ohio EPA 1998b) concluded that the fish and invertebrate populations of Little Beaver Creek were not being impacted by pollutants from PORTS.

An ecological risk assessment (DOE 1996b) was conducted for the creeks and ditches of PORTS. The basic conclusions are that plant communities may be affected in some locations by contaminants from the site and that invertebrate populations in soils are adversely affected by some site contaminants along most of the creeks and ditches. In addition, the fish and aquatic invertebrates in Big Run Creek were being adversely affected. However, Big Run Creek was rerouted after the study and no subsequent information is available. Impacts to other wetlands and air do not appear to be affecting the local flora or fauna.

4.8.2 Current State

All of the creeks or ditches are either directly sampled as NPDES outfalls or through the site surface water monitoring program.

4.8.2.1 Media and pathways

The current state CSM (Fig. 4.8a2) show sediment and waste from past enrichment operations including scrap are identified as current sources of contamination. Contaminants found in either media are available for direct contact on site or for transport to areas outside the industrialized area of PORTS. Once in the environment, contaminants could directly affect ecological receptors or enter the food chain.

Using the current state CSM (Fig. 4.8a2), the source material (i.e., scrap), sediments, and surface water are of concern. Receptors potentially exposed to source material are general site workers, visitors, and ecological receptors. Receptors potentially exposed to sediment and surface water are also general site workers, visitors, and ecological receptors. The visitor and ecological receptor are potentially exposed through the food chain. Pathways considered for workers and visitors include ingestion, inhalation, dermal contact and direct exposure (radiation only). Ecological pathways vary depending on the type of organism, but include respiratory uptake, ingestion and dermal contact.

Under current conditions, the barriers to exposure and processes to reduce exposure (Figs. 4.8a1 and 4.8a2) are access controls to prevent exposure to source material ① and the deed notation that prohibits the use of groundwater ③. In addition, monitoring of effluents is ongoing to ensure that any future releases would be identified quickly ⑧. Monitoring of groundwater indicates that currently no contaminated groundwater is leaving the site ⑨ and natural attenuation of surface water with verification by monitoring ⑩ is reducing exposure levels to contaminants.

4.8.2.2 Risk levels

The unmitigated risk from creeks and ditches ranges from less than $1x10^{-6}$ to $1.8x10^{-3}$. The maximum risk for surface water is in the West Drainage Ditch for the future recreational visitor exposed to soil and sediments. The primary risk drivers are metals (e.g., chromium, arsenic and uranium), PAHs, and PCBs. The HI ranges from less than 1 to 26.3 for a future recreational visitor in the Northeast Drainage Ditch. These risks are calculated for a point of contact within each SWMU. The risk levels and risk drivers are presented in Table 4.1 for all SWMUs by hazard area.

4.8.3 ES Vision

Under the ES Vision, the site is an industrial/commercial facility with access inside Perimeter Road restricted to workers. These workers are protected from contaminants in the surface water and sediments by the work permit process, which requires permits and appropriate PPE for all work involving contaminated media. Workers and recreational visitors to areas outside the secured area will be warned by signs and public information meetings of the hazards at the site. As remediation of the groundwater and soil contamination sources proceeds, the source of contaminants to the creeks and ditches would be removed, and natural processes may clean the water and sediments. Remedial actions may be undertaken to remove contaminated sediments from some areas of the creeks; however, the extent of remediation will not be determined until after the rest of the site has undergone D&D activities. The goal will be to maintain an industrial worker exposure level within an industrial risk range of $1x10^{-4}$ to $1x10^{-6}$.

4.8.3.1 Media and pathways

Using the ES Vision CSM (Fig. 4.8b2), the media and pathways are the same as for the current state discussed in Section 4.8.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the ES Vision.

The barriers to exposure and processes to reduce exposure under the ES Vision (Figs. 4.8b1 and 4.8b2) are access controls to prevent exposure to source material ① and the deed notation that prohibits the use of groundwater ③. In addition, monitoring of effluents is ongoing to ensure that any future releases are identified quickly ⑧. Monitoring of groundwater would continue to ensure that no contaminated groundwater is leaving the site ⑨ without appropriate mitigative measures, and natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants.

Under the ES Vision, potential receptors during implementation of the remedies in the surface water hazard areas (Fig. 4.8b3) are the maintenance worker, environmental sampler, remediation worker, general site worker, transportation worker, disposal worker and the public. The maintenance worker could be exposed during the maintenance of access controls. The environmental sampler could be exposed during sampling activities. The remediation worker and general site worker could be exposed during implementation of the source actions. The transportation worker and public could be exposed during transportation of the waste to an offsite disposal facility. The disposal worker could be exposed during the disposal of the waste at the offsite facility. Ecologic receptors could be exposed and disturbed during any remedial action.

4.8.3.2 Risk levels

Under the ES Vision, the projected risk from creeks and ditches would be *de minimis* for all receptors due to access controls and source removal. Risks would be calculated based on samples from within each SWMU for all media except groundwater. The groundwater point of compliance would be the site boundary; therefore, groundwater risk would be calculated based on samples collected from the site boundary.

4.8.4 Current Baseline End State

In the current baseline end state, the site is an industrial/commercial facility with access inside Perimeter Road restricted to workers. These workers are protected from contaminants in the surface water and sediments by the work permit process, which requires permits and appropriate PPE for all work involving contaminated media. Workers and recreational visitors to areas outside the secured area will be warned by signs and public information meetings of the hazards at the site. As remediation of the groundwater and soil contamination sources proceeds, the source of contaminants to the creeks and ditches will be removed, and natural processes may clean the water and sediments. Remedial actions may be undertaken to remove contaminated sediments form some areas of the creeks. Regulators are requiring that the point of departure for risk to industrial workers and recreational users be at a risk level of $1x10^{-6}$ for their specified scenario.

4.8.4.1 Media and pathways

Using the current baseline end state CSM (Fig. 4.8c2), the media and pathways are the same as for the current state discussed in Section 4.8.2.1. This discussion will focus on barriers to exposure and processes used to reduce or monitor exposures to achieve the current baseline end state.

The barriers to exposure and processes to reduce exposure under the current baseline end state (Figs. 4.8c1 and 4.8c2) are continued access controls to prevent exposure to source material ① and continuation of the current deed notation that prohibits the use of groundwater ③. Remedial actions are planned in other hazard areas under the current baseline end state to remove the sources of surface water contamination. To ensure that migration to areas outside the industrialized area is slowed, standard construction practices such as migration controls (i.e., sediment control basins) would be employed. Monitoring of effluents would continue to ensure any future releases would be identified quickly ⑧. Monitoring of groundwater would continue to ensure that no contaminated groundwater is leaving the site ⑨ without appropriate mitigative measures, and natural attenuation of surface water with verification by monitoring ⑩ would continue to reduce exposure levels to contaminants.

Under the current baseline end state, potential receptors during implementation of the remedies (Fig. 4.8c3) are the maintenance worker, environmental sampler, remediation worker, general site worker, transportation worker, disposal worker and the public. The maintenance worker could be exposed during the maintenance of access controls. The environmental sampler could be exposed during sampling activities. The remediation worker and general site worker could be exposed during implementation of the source actions. The transportation worker and public could be exposed during transportation of the waste to an offsite disposal facility. The disposal worker could be exposed during the disposal of the waste at the offsite facility. Ecologic receptors could be exposed and disturbed during any remedial action.

4.8.4.2 Risk levels

Under the current baseline end state, the projected risk levels, after the source areas are cleaned, would be *de minimis* for all receptors. Risks would be calculated within each SWMU for all media.

4.8.5 Risk Balancing

The current baseline end state and the ES Vision for the surface water hazard area are very similar in that both envision that there will be some contaminated sediment removal to achieve the end state. Since all the units have been deferred, it is assumed that the cleanup goals, under the current baseline end state, will be the same as other cleanup goals already established in PORTS decision documents and will be the lower of either risk based or concentration based cleanup goals. It is presumed that Big Run Creek and the East Drainage Ditch are already at their ES Vision risk level since they already meet the $1x10^{-4}$ to $1x10^{-6}$ industrial risk range. The difference in presumption between the two end states provides a difference in the risk levels to receptors resulting from the volume of the removals. For the current baseline end state, there will be higher potential short-term risk levels for remediation workers, transportation workers, disposal workers and the public. While in the ES Vision, the short-term risks would be lower for remediation workers, transportation workers, disposal workers and the public, the potential long-term risk to site workers, ecological receptors and recreational visitors would be higher. Both end states would be protective of human health and the environment, and risks would be *de minimis*.

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Table 4.1. Human health risk assessment summary for identified hazard areas [a]

Solid Waste Management Unit	Land Use	Hazard Area	Unmitigated Risk[b]	Hazard Index	Risk Scenario	Contaminant Description	PRG or Cleanup Goal
Hazard Area 1: Groundwater Plumes and Sources							
X-611A	Industrial	Groundwater	6.7×10^{-4}	3.86	Future Worker	Arsenic	1.67 µg/L
X-616	Industrial	Groundwater	8.08×10^{-5}		Future Worker (Gallia)[d]	1,1-DCE	1.86 µg/L
X-633	Industrial	Groundwater	8.6×10^{-4}	5.8	Future Worker (Gallia)[d]	Arsenic	1.67 µg/L
X-701B	Industrial	Groundwater	4×10^{-4}	NA	Industrial Worker/ Recreational User[c]	TCE	1.3 mg/L
X-705	Industrial	Groundwater	3.2×10^{-3}	17.6	Future Worker (Berea)[d]	Arsenic	1.67 µg/L
Peter Kiewitt Landfill/XT-847 Warehouse	Industrial	Groundwater	1.9×10^{-4}	1.61	Future Recreational Visitor	PCBs, Arsenic	NE, 23 mg/kg
X-734, 734A, 734B	Industrial	Groundwater	1.2×10^{-3}	6.6	Future Worker (Gallia)[d]	Arsenic, Beryllium, PAH	33 mg/kg, 1.7 mg/kg, 290 µg/kg
X-735	Industrial	Groundwater	3×10^{-4}	2.27	Future Worker (Gallia)[d]	Arsenic, Beryllium	18.4 mg/kg, 23 mg/L
X-740	Industrial	Groundwater	4.6×10^{-3}	4.4	Future Worker (Gallia)[d]	1,1-DCE, TCE	1.86 µg/L, 100 µg/L
X-749A	Industrial	Groundwater	4.4×10^{-3}	26.8	Future Worker (Berea)[d]	Arsenic	0.13 mg/L
X-749	Industrial	Groundwater	2.7×10^{-6}	1.37	Excavation Worker	Antimony, Arsenic	0.24 mg/kg, 18.4 mg/kg
Hazard Area 2: Surface Soil and Sources							
X-342A	Industrial	Soil	1.0×10^{-5}	0.618	Future Recreational Visitor	PAHs, Arsenic	NE
X-344D	Industrial	Soil	4.5×10^{-5}	0.02	Current Worker	Fluoride	NE
X-600	Industrial	Soil	BC	BC	–	–	NE
X-600A/X-621	Industrial	Soil	4.4×10^{-3}	26.9	Future Worker (Berea)[d]	Arsenic	8.4 mg/kg
X-626	Industrial	Soil	2.4×10^{-5}	0.7	Excavation Worker	Beryllium, Chromium	1.4 mg/kg, NE

Table 4.1. Human health risk assessment summary for identified hazard areas (continued) [a]

Solid Waste Management Unit	Land Use	Hazard Area	Unmitigated Risk[b]	Hazard Index	Risk Scenario	Contaminant Description	PRG or Cleanup Goal
Hazard Area 2: Surface Soil and Sources (continued)							
X-630-1, -2, -3	Industrial	Soil	7.4×10^{-4}	5.1	Future Worker (Gallia)[d]	Arsenic	97 µg/L
X-700	Industrial	Soil	4.7×10^{-6}	0.2	Excavation Worker	PCBs, PAHs	0.74 mg/kg, NE
X-701	Industrial	Soil	7.4×10^{-6}	0.04	Current Worker	Arsenic, PAHs	33 mg/kg, NE
X-705A/X-705B	Industrial	Soil	2×10^{-4}	0.4	Future Worker (Berea)[d]	Total Uranium	NE
X-720	Industrial	Soil	3.1×10^{-3}	18	Future Worker (Berea)[d]	Arsenic	18.4 mg/kg
X-744G	Industrial	Soil	1.7×10^{-2}	114	Future Worker (Berea)[d]	Arsenic	18.4 mg/kg
X-744N,P Q	Industrial	Soil	5×10^{-4}	4.6	Future Worker (Berea)[d]	Arsenic, Antimony	18.4 mg/kg, 0.24 mg/kg
X-747H	Industrial	Soil	1.2×10^{-3}	0.084	Future Worker (Gallia)[d]	Arsenic, Chromium	18.4 mg/kg, 2,210 mg/L
Don Marquis Substation	Industrial	Soil	NFA	–	–	–	–
X-530	Industrial	Soil	1.5×10^{-2}	0.07	Current Worker	PAHs	110 µg/kg
X-533A	Industrial	Soil	2.25×10^{-4}	2.54	Future Worker (Gallia)[d]	Arsenic	33 mg/kg
Hazard Area 3: Landfills							
Peter Kiewitt Landfill/XT-847 Warehouse	Industrial	Landfill	1.9×10^{-4}	1.61	Future Recreational Visitor	PCBs, Arsenic	NE, 23 mg/kg
X-749B	Industrial	Landfill	2.7×10^{-6}	1.37	Excavation Worker	Antimony, Arsenic	0.24 mg/kg, 18.4 mg/kg
X-231A	Industrial	Landfill	4.5×10^{-3}	26.9	Future Worker[d]	Arsenic	1.67 µg/L
X-231B	Industrial	Landfill	NA	NA			
X-734, 734A, 734B	Industrial	Landfill	1.2×10^{-3}	6.6	Future Worker (Gallia)[d]	Arsenic, Beryllium, PAH	33 mg/kg, 1.7 mg/kg, 290 µg/kg
X-735	Industrial	Landfill	3×10^{-4}	2.27	Future Worker (Gallia)[d]	Arsenic, Beryllium	18.4 mg/kg, 23 mg/L
X-749A	Industrial	Landfill	4.4×10^{-3}	26.8	Future Worker (Berea)[d]	Arsenic	0.13 mg/L

Table 4.1. Human health risk assessment summary for identified hazard areas (continued) [a]

Solid Waste Management Unit	Land Use	Hazard Area	Unmitigated Risk[b]	Hazard Index	Risk Scenario	Contaminant Description	PRG or Cleanup Goal
Hazard Area 4: Legacy Waste and DMSAs							
X-700	Industrial	DMSA	4.7×10^{-6}	0.2	Excavation Worker	PCBs, PAHs	NE, 0.74 mg/kg
X-7725/X-7745R	Industrial	Legacy Waste	NA	NA	–	–	–
X-326	Industrial	DMSA/Legacy	BC	BC	–	–	–
X-330	Industrial	DMSA	BC	BC	Future Worker (Soil)	–	–
X-333	Industrial	DMSA	1.3×10^{-3}	0.405	Current Worker	PAHs	290 µg/kg
Hazard Area 5: Cylinder Yards							
X-744	Industrial	Cylinder Yard	BC	BC	–	–	–
X-745A	Industrial	Cylinder Yard	BC	BC	–	–	–
X-745B	Industrial	Cylinder Yard	3.8×10^{-5}	0.071	Current Worker	U-235, U-238, PAHs	17 mg/kg U_{total}, 290 µg/kg
X-745C	Industrial	Cylinder Yard	4×10^{-4}	2.12×10^{-1}	Current Worker	Beryllium, Arsenic	1.7 mg/kg, 33 mg/kg
X-745E	Industrial	Cylinder Yard	BC	BC	–	–	–
X-745F	Industrial	Cylinder Yard	1.8×10^{-4}	1.16	Future Worker (Berea)[d]	Arsenic	33 mg/kg
X-745G	Industrial	Cylinder Yard	NA	NA	–	–	–
X-745H	Industrial	Cylinder Yard	NA	NA	–	–	–
Hazard Area 6: GDP Facilities							
X-330	Industrial	GDP	3.5×10^{-4}	2.3	Future Worker (Gallia)[d]	Arsenic	0.6 mg/L
X-333	Industrial	GDP	1.3×10^{-3}	0.405	Current Worker	PAHs	290 µg/kg
X-326	Industrial	GDP	1.7×10^{-3}	9.25	Future Worker (Berea)[d]	Arsenic	0.6 mg/L
X-705	Industrial	GDP	3.2×10^{-3}	17.6	Future Worker (Berea)[d]	Arsenic	0.6 mg/L
X-710	Industrial	GDP	2.6×10^{-3}	18.7	Future Worker (Gallia)[d]	Arsenic	0.6 mg/L
Hazard Area 7: Surface Water Impoundments							
Chemical and Petroleum Containment Basins	Industrial	Surface Impoundment	4.2×10^{-6}	–	Current Worker	PAHs	290 µg/kg
Chemical and Petroleum Containment Basins	Industrial	Surface Impoundment	4.2×10^{-6}	–	Current Worker	PAHs	290 µg/kg

Table 4.1. Human health risk assessment summary for identified hazard areas (continued) [a]

Solid Waste Management Unit	Land Use	Hazard Area	Unmitigated Risk[b]	Hazard Index	Risk Scenario	Contaminant Description	PRG or Cleanup Goal
Hazard Area 7: Surface Water Impoundments (continued)							
X-2230M	Industrial	Surface Impoundment	8×10^{-6}	0.24	Current/Future Worker	Arsenic, PAHs	18.2 mg/kg, NE
X-2230N	Industrial	Surface Impoundment	3.3×10^{-5}	1.28	Future Recreational Visitor	Arsenic, Beryllium, PCBs	33 mg/kg, 1.7 mg/kg, 190 µg/kg
X-230J3	Industrial	Surface Impoundment	3.5×10^{-3}	17	Future Worker (Gallia)[d]	Arsenic	0.3 mg/L
X-230J5	Industrial	Surface Impoundment	1.8×10^{-4}	2.01	Future Recreational Visitor	PAHs, Antimony, Arsenic, Manganese	NE, 0.06 mg/L, 0.3 mg/L, 0.2 mg/L
X-230J6	Industrial	Surface Impoundment	1.2×10^{-3}	6.5	Future Recreational Visitor	Chromium, Arsenic	1,071 mg/kg, 1.23 mg/kg
X-230J7	Industrial	Surface Impoundment	9.2×10^{-5}	0.9	Future Recreational Visitor	Arsenic, PAHs	23 mg/kg, NE
X-230K	Industrial	Surface Impoundment	4.4×10^{-3}	26.8	Future Worker (Berea)[d]	Arsenic, Beryllium, Antimony	1.05 mg/L, 23 mg/L, 0.06 mg/L
X-230L	Industrial	Surface Impoundment	1.3×10^{-4}	8	Current/Future Worker	PAHs	NE
Hazard Area 8: Surface Water							
Little Beaver Creek	Industrial	Surface Water	1.16×10^{-4}	1.6	Future Recreational Visitor	PAHs, PCBs, Arsenic	NE, NE, 1.49 mg/kg
Big Run Creek	Industrial	Surface Water	2×10^{-5}	0.6	Future Recreational Visitor	Arsenic	23 mg/kg
East Drainage Ditch	Industrial	Surface Water	2×10^{-5}	0.9	Future Recreational Visitor	Arsenic, Manganese	1.58 mg/kg, 1.38 mg
Northeast Drainage Ditch	Industrial	Surface Water	1.7×10^{-3}	26.3	Future Recreational Visitor	Arsenic, Chromium	232 mg/kg, 2.52 mg/L

Table 4.1. Human health risk assessment summary for identified hazard areas (continued) [a]

Solid Waste Management Unit	Land Use	Hazard Area	Unmitigated Risk[b]	Hazard Index	Risk Scenario	Contaminant Description	PRG or Cleanup Goal
Hazard Area 8: Surface Water (continued)							
North Drainage Ditch	Industrial	Surface Water	1.3×10^{-4}	8	Current/Future Worker	PAHs	290 µg/kg
West Drainage Ditch	Industrial	Surface Water	1.8×10^{-3}	6.07	Future Recreational Visitor	PAHs, Manganese	NE, 703 mg/kg,

NFA – No Further Action. Site has been determined to need no further action

BC – Below Concern. Risk and Hazard levels are below 1×10^{-6} or an HI of 1

NA – Not Applicable. No risk numbers are currently available.

NE – Not Estimated. No risk numbers are currently available.

[a] The data contained within this table use data in effect at the time the Human Health Risk Assessment was performed and may not reflect actual current risk. All scenarios are from the BHHRA 1995 and the Quadrant RFI reports of 1995 and represent unmitigated risk for each SWMU.

[b] The unmitigated risk is presented in this table. The projected end state risk for each receptor scenario within all hazard areas is within the risk range 1×10^{-4} to 1×10^{-6}.

[c] The risk is derived from the Industrial Recreational User evaluated in the technical memorandum on PRGs (SAIC 2003) but uses the full TCE concentration rather than a diluted one.

[d] The risk includes a groundwater pathway including dermal contact and ingestion of onsite groundwater.

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5. END STATE VISION VARIANCE REPORT

This chapter presents the differences between the current PORTS baseline end state per existing regulatory agreements and the ES Vision that were identified in the comparisons presented in the hazard-specific context discussion of Chap. 4. The impacts that arise from these variances are identified and described in this chapter in terms of scope, cost, schedule, and risk. A discussion of the barriers in achieving the ES Vision and recommendations for overcoming these barriers are also provided.

In general, no significant changes in contaminant release, transport, and exposure mechanisms or in receptors were identified between the current baseline end state and the ES Vision, primarily due to the extent of the cleanup actions already accomplished at PORTS. However, a major difference occurs in the approach for final groundwater cleanup with respect to points of compliance. Tables 5.1 and 5.2 present a summary of the variance and cost variance discussions, respectively, presented herein.

Figure 5.1a shows the current baseline end state land use based on the 1995 land use survey that considered stakeholder input at that time. Land use inside Perimeter Road would be either existing industrial or large scale office/industrial. Land use outside Perimeter Road would be large scale office/industrial, rail/industrial, retail and service, or small scale office/industrial. (Note that the colors used on this figure are not consistent with the ES Vision guidance, as the land use designations from the 1995 land use survey (DOE 1995a) do not fall within categories that fit within the DOE ES guidance.)

Figure 5.1b depicts land use under the PORTS ES Vision. Land use inside Perimeter Road and areas of landfills and groundwater plumes that fall outside of Perimeter Road would be DOE-controlled industrial. Land use for the remaining areas outside of Perimeter Road would be commercial and/or open space/recreational.

5.1 VARIANCE 1: POINT OF COMPLIANCE IN GROUNDWATER

The point of compliance in groundwater at PORTS can be broken down into two categories: physical point of compliance (i.e., where PORTS must determine compliance, such as within the body of the groundwater plume versus the DOE property boundary) and concentration point of compliance (i.e., MCLs or a risk level of $1x10^{-6}$ versus a risk range of $1x10^{-4}$ to $1x10^{-6}$). The following discussion details the point of compliance variance between the current baseline end state and the ES Vision.

5.1.1 Impacts

This discussion describes the impacts on scope, cost, schedule, and risk assumed with this variance.

5.1.1.1 Scope

Current Baseline End State

For the current planned baseline end state, PORTS' cleanup is subject to drinking water standards because the Ohio EPA and U.S. EPA consider PORTS' groundwater throughout the site to be potable and because they do not recognize the deed notation currently filed with Pike County that restricts the use of groundwater. This requires PORTS to: 1) calculate risk based upon on-site workers drinking and showering with the groundwater (i.e., dermal and ingestion exposure risk scenarios); and 2) attain MCLs (i.e., $1x10^{-6}$ risk level) with a physical point of compliance throughout all groundwater within the site (including areas of remedial actions within each plume) within a 30-year period (based on RCRA Corrective Action requirements). Further, PORTS must employ best available technology (BAT) and as low as reasonably achievable (ALARA) methods to achieve the $1x10^{-6}$ risk level requirement. Prior to considering an alternative cleanup level that falls within a risk range of $1x10^{-4}$ to $1x10^{-6}$, the regulators require PORTS to demonstrate the inability to achieve a risk level of $1x10^{-6}$ within the groundwater plume through failure of implemented BAT and ALARA methods over a reasonable period of time (e.g. five-year remedial action evaluation), despite national performance data indicating that no technologies currently exist that can reduce DNAPLs in source areas within this time period. In addition, implemented remedial actions are required to be evaluated for effectiveness on a five-year timeframe, which may not permit sufficient time for some remedies to demonstrate effectiveness in achieving the cleanup goals established in Decision Documents and could result in a premature determination of whether additional remedial actions are necessary.

ES Vision

Under the ES Vision, the groundwater beneath PORTS would continue to be restricted, through deed notation recorded in the Pike County Recorder's Office, and on-site workers would not use groundwater for drinking or showering. Thus, dermal and ingestion exposure risk scenarios would not apply, and PORTS would not be required to meet MCLs (i.e., $1x10^{-6}$ risk level). The site boundary would be the physical point of compliance to reach a risk range of $1x10^{-4}$ to $1x10^{-6}$ for cleanup of contaminants in groundwater, rather than MCLs within the body of the groundwater plume, which would allow for monitored natural attenuation to occur over time for most plumes (would not apply to X-749/X-120 plume due to its proximity to the property boundary).

5.1.1.2 Cost

Table 5.2 details the estimated cost variance between the current baseline end state and the ES Vision. The estimate is generally based on the PORTS life-cycle baseline costs (see Appendix A) and is escalated at 4% per year through FY 2034. The costs include remediation, post-remediation, surveillance and maintenance, and environmental monitoring. The estimated cost to achieve the ES Vision in groundwater is approximately \$225.2M. The estimated cost to achieve the current planned baseline end state is approximately \$372M. The cost to achieve the ES Vision would be approximately \$146.8M less than the cost to achieve the current planned baseline end state.

The difference between the estimated costs for both end states is due primarily to the cessation of some remediation activities currently ongoing within the X-701B plume. Under the ES Vision: oxidant injection O&M (\$140.2M) would cease; the five-year remedial action evaluation (\$680K) associated with the oxidant injection would cease; the X-701B cap (\$5.3M) would not be constructed; the X-701B cap O&M (\$340K) would not occur; and replacement of 20 phytoremediation trees per year (\$280K) for the X-740 plume would not occur.

5.1.1.3 Schedule

The current life-cycle baseline shows remediation activities completed in FY 2009. The life-cycle baseline includes post-remediation surveillance and maintenance activities and environmental monitoring ongoing through FY 2036. It is anticipated that under the ES Vision, the schedule for implementing remedial actions would be reduced as a result of the point of compliance being established at the site boundary with a risk range of $1x10^{-4}$ to $1x10^{-6}$, rather than meeting MCLs within the body of the groundwater plume. This is due to the cessation of the remediation activities currently ongoing within the X-701B and X-740 groundwater plumes, discussed above in Sect. 5.1.1.2, and due to not being required to demonstrate technology failure.

5.1.1.4 Risk

The current baseline end state reflects a 1×10^{-6} point-of-departure as a cleanup goal and an acceptable risk range of 1×10^{-4} to 1×10^{-6} for contaminants throughout PORTS. Based on this approach, DOE is required to initiate efforts to meet MCLs or achieve a 1×10^{-6} risk level before the regulators will agree to a cleanup goal that falls within a 1×10^{-4} to 1×10^{-6} risk range, with the body of the groundwater plume as the point of compliance. Under the ES Vision, an acceptable cleanup risk range of 1×10^{-4} to 1×10^{-6} would be set from the beginning of site cleanup (without requiring initial use of a 1×10^{-6} risk level as a point of departure), with the DOE site boundary as the point of compliance.

5.1.2 Barriers in Achieving ES Vision

The regulators take the position that: 1) PORTS' groundwater throughout the site is potable and can be used for drinking or showering; and 2) the deed notation currently filed with Pike County that restricts the use of groundwater at PORTS is not recognized as having a bearing on cleanup criteria. Because of these positions, PORTS is subject to drinking water standards. This requires PORTS to calculate risk based upon on-site workers drinking and showering with the groundwater (i.e., dermal and ingestion exposure risk scenarios) despite the fact that such uses of groundwater are prohibited at PORTS. Thus, PORTS must attain MCLs (i.e., 1×10^{-6} risk level) for all groundwater within the site, including areas of remedial actions throughout each plume within a 30-year period (based on RCRA Corrective Action requirements). In addition, PORTS must employ BAT and ALARA methods to attempt to achieve the 1×10^{-6} risk level requirement. DOE's position is that the groundwater beneath PORTS has not been used, is not currently used, and will not be used in the future, as the three well fields along the Scioto River will continue to supply water to the site and continue to be treated on site at the X-611 Water Treatment Plant. Further, the deed notation filed with Pike County restricts the use of groundwater at the site. Thus, the on-site worker would not use groundwater for drinking or showering, so dermal and ingestion exposure scenarios would not apply, and PORTS would not be required to meet MCLs (i.e., 1×10^{-6} risk level).

Prior to considering an alternative cleanup level that falls within a risk range of 1×10^{-4} to 1×10^{-6}, the regulators require that PORTS must first demonstrate the inability to achieve a risk level of 1×10^{-6} within the groundwater plume through failure of implemented BAT and ALARA methods over a reasonable period of time (e.g. five-year remedial action evaluation), despite national performance data indicating that no technologies currently exist that can reduce DNAPLs in source areas within this time period. In addition, implemented remedial actions are required to be evaluated for effectiveness on a five-year timeframe. DOE's position is that the five-year evaluation period may not permit sufficient time for some remedies to demonstrate effectiveness in achieving the cleanup goals established in Decision Documents and could result in a premature determination of whether additional remedial actions are necessary. Further, having the property boundary as the physical point of compliance (rather than the body of the plume) would allow for monitored natural attenuation to occur over time for most plumes (would not apply to the X-749/X-120 Plume due to its proximity to the property boundary) and would preclude the need for a demonstrated technology failure.

5.1.3 Recommendations for Overcoming Barriers

Should the DOE choose to pursue the ES Vision, the barriers discussed in Sect. 5.1.2 will have to be overcome. To achieve surmounting these barriers, it is recommended that the DOE initiate a series of discussions with the regulators aimed at: seeking agreement that, because groundwater use at PORTS is restricted via deed notation currently filed with Pike County, risk would not be calculated based upon workers drinking or showering with the groundwater; seeking agreement that risk scenarios and cleanup standards for cleanup actions would be based upon actual current and future land use for the area in question (e.g., industrial worker risk scenario inside Perimeter Road) within a risk range of $1x10^{-4}$ to $1x10^{-6}$ rather than using a $1x10^{-6}$ point of departure for cleanup throughout the entire site; determining willingness to consider establishing groundwater points of compliance and exposure at the property boundary in conjunction with monitored natural attenuation in lieu of source and plume actions; and determining the appropriateness of requiring a demonstrated technology failure, given the national performance data; and determining what would be required to decide whether a technology impracticability waiver should apply.

Table 5.1. PORTS ES vision variance report

ID. No.	Description of Variance/Hazard Areas Affected	Impacts	Barriers in Achieving ES Vision	Recommendations
V-1	**Point of Compliance in Groundwater** **Current Planned Baseline End State:** PORTS must meet drinking water standards (i.e., $1x10^{-6}$ risk level) in groundwater, with the body of the contaminated plume as the groundwater point of compliance. **ES Vision:** ES Vision applies a risk range of $1x10^{-4}$ to $1x10^{-6}$ as initial cleanup goal, with the DOE property boundary as the groundwater point of compliance for. **Hazard Area Affected:** 1. Groundwater plumes and sources	Scope: For the current planned baseline end state, the Ohio EPA and U.S. EPA: 1) consider PORTS' groundwater throughout the site to be potable; and 2) the deed notation currently filed with Pike County that restricts the use of groundwater at PORTS is not recognized as having a bearing on cleanup criteria. Because of these positions, PORTS is subject to drinking water standards. This requires PORTS to calculate risk based upon on-site workers drinking and showering with the groundwater (i.e., dermal and ingestion exposure risk scenarios). Thus, PORTS must attain MCLs (i.e., $1x10^{-6}$ risk level) for all groundwater within the site, including areas of remedial actions throughout each plume within a 30-year period (based on RCRA Corrective Action requirements). Further, PORTS must employ BAT and ALARA methods to attempt to achieve the $1x10^{-6}$ risk level requirement. Prior to considering an alternative cleanup level that falls within a risk range of $1x10^{-4}$ to $1x10^{-6}$, the regulators require that PORTS must first demonstrate the inability to achieve a risk level of $1x10^{-6}$ within the groundwater plume through failure of implemented BAT and ALARA methods over a reasonable period of time (e.g. five-year remedial action	1. The regulators' position is that PORTS' groundwater throughout the site is potable. 2. The regulators do not recognize the deed notation currently filed with Pike County that restricts the use of groundwater at PORTS. 3. Because of barriers 1 and 2 above, PORTS is subject to drinking water standards, requiring risk to be calculated based upon on-site workers drinking and showering with the groundwater (i.e., dermal and ingestion exposure risk scenarios). 4. Because of barrier 3, PORTS must attain MCLs (i.e., $1x10^{-6}$ risk level) for all groundwater within the site, including areas of remedial actions throughout each plume within a 30-year period (based on RCRA Corrective Action requirements). 5. PORTS must employ BAT and ALARA methods to achieve the 1x10-6 risk level requirement	Initiate further discussions with the regulators to: • seek agreement that because groundwater use at PORTS is restricted via deed notation currently filed with Pike County, risk would not be calculated based upon workers drinking or showering with the groundwater; • seek agreement that risk scenarios and cleanup standards for cleanup actions would be based upon actual current and future land use for the area in question (e.g., industrial inside Perimeter Road) within a risk range of $1x10^{-4}$ to $1x10^{-6}$ rather than using a $1x10^{-6}$ point of departure for cleanup throughout the entire site; • determine willingness to consider establishing groundwater points of compliance and exposure at property boundary in conjunction with monitored natural attenuation in lieu of source and plume actions; • determine the appropriateness of requiring a demonstrated technology failure, given national performance data;

Table 5.1. PORTS ES vision variance report (continued)

ID. No.	Description of Variance/Hazard Areas Affected	Impacts	Barriers in Achieving ES Vision	Recommendations
V-1 (cont.)		evaluation), despite national performance data indicating that no technologies currently exist that can reduce DNAPLs in source areas within this time period. In addition, implemented remedial actions are required to be evaluated for effectiveness on a five-year timeframe. Under the ES Vision, the groundwater beneath PORTS would continue to be restricted, through deed notation recorded in the Pike County Recorder's Office. Therefore, on-site workers would not use groundwater for drinking or showering so dermal and ingestion exposure risk scenarios would not apply and, PORTS would not be required to meet MCLs (i.e., risk level of $1x10^{-6}$). The site boundary would be the physical point of compliance to reach a risk range of $1x10^{-4}$ to $1x10^{-6}$ for cleanup of contaminants in groundwater, rather than MCLs within the body of the groundwater plume, which would allow for monitored natural attenuation to occur over time for most plumes (would not apply to X-749/X-120 plume due to its proximity to the property boundary). <u>Cost</u>: The estimated cost to achieve the ES Vision in groundwater is approximately $225.2M. The estimated cost to achieve the current planned	6. Prior to considering an alternative cleanup level that falls within a risk range of 1x10-4 to 1x10-6, the regulators require that PORTS must first demonstrate the inability to achieve a risk level of 1x10-6 within the groundwater plume through failure of implemented BAT and ALARA methods over a reasonable period of time (e.g. five-year remedial action evaluation). 7. Implemented remedial actions are required to be evaluated for effectiveness on a five-year timeframe, which may not permit sufficient time for all remedies to demonstrate effectiveness in achieving the cleanup goals established in Decision Documents and could result in a premature determination of whether additional remedial actions are necessary. 8. Not having the property boundary as the physical point of compliance (rather than the body of the plume) does not allow for taking advantage of monitored natural attenuation to	• determine what would be required to decide whether a technology impracticability waiver should apply.

Table 5.1. PORTS ES vision variance report (continued)

ID. No.	Description of Variance/Hazard Areas Affected	Impacts	Barriers in Achieving ES Vision	Recommendations
V-1 (cont.)		baseline end state is approximately \$372M. The cost to achieve the ES Vision would be approximately \$146.8M less than the cost to achieve the current planned baseline end state. This estimate is generally based on the PORTS life-cycle baseline costs through FY 2034 (see Appendix A) and is escalated at 4% per year and includes remediation, post-remediation, surveillance and maintenance, and environmental monitoring. Table 5.2 details the estimated cost variance between the two end states. <u>Schedule</u>: The current life-cycle baseline shows remediation activities completed in FY 2009. The life-cycle baseline includes post-remediation surveillance and maintenance activities and environmental monitoring ongoing through FY 2036. It is anticipated that under the ES Vision, the schedule for implementing remedial actions would be reduced as a result of the point of compliance being established at the site boundary with a risk range of $1x10^{-4}$ to $1x10^{-6}$, rather than meeting MCLs within the body of the groundwater plume. This is due to the cessation of the remediation activities currently ongoing within the X-701B and X-740 groundwater plumes, discussed above in Sect. 5.1.1.2, and due to not being	occur over time for most plumes (would not apply to the X-749/X-120 plume due to its proximity to the property boundary) and therefore PORTS must continue with demonstrated technology failure. 9. Existing RCRA Decision Documents would need to be changed.	

Table 5.1. PORTS ES variance report (continued)

ID. No.	Description of Variance/Hazard Areas Affected	Impacts	Barriers in Achieving ES vision	Recommendations
V-1 (cont.)		required to demonstrate technology failure. <u>Risk</u>: The current baseline end state reflects a $1x10^{-6}$ point-of-departure as a cleanup goal and an acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$ for contaminants throughout PORTS. Based on this approach, DOE is required to initiate efforts to meet MCLs or achieve a $1x10^{-6}$ risk level before the regulators will agree to a cleanup goal that falls within a $1x10^{-4}$ to $1x10^{-6}$ risk range, with the body of the groundwater plume as the point of compliance. Under the ES Vision, an acceptable cleanup risk range of $1x10^{-4}$ to $1x10^{-6}$ would be set from the beginning of site cleanup (without requiring initial use of a $1x10^{-6}$ risk level as a point of departure), with the DOE site boundary as the point of compliance.		

Table 5.2. PORTS estimated cost variance [a]

Cost Element	Cost per Element	Year 1 (FY 2004)	Current Baseline End State [b]	ES Vision [b]
X-740 Groundwater Plume				
Groundwater sampling and reporting.	$29,206		$1,638,017	(same)
Annual monitoring well inspections, evaluations, and reporting	$10,000		$560,849	(same)
5-year remedial action evaluation [c]	$150,000		$1,020,287	(same)
Replanting and replacement of 20 phytoremediation trees	$5,000		$280,425	$0
	X-740 groundwater plume cost variance:		**$3,499,578**	**$3,219,153**
Quadrant II: 7–Unit Groundwater Plume				
Groundwater sampling and reporting.	$23,612		$1,324,278	(same)
Annual monitoring well inspections, evaluations, and reporting.	$10,000		$560,849	(same)
5-year remedial action evaluation [c]	$100,000		$680,191	(same)
X-622T O&M until 9/30/04	$925,000	$925,000	$925,000	(same)
X-627 construction	$3,600,000	$3,600,000	$3,600,000	(same)
X-627 O&M for 30 years	$925,000		$3,000,143	(same)
NPDES sampling	$3,231		$10,479	(same)
	Quadrant II: 7–Unit groundwater plume cost variance:		**$10,100,940**	**(same)**
Quadrant I: 5–Unit Groundwater Plume				
Groundwater sampling and reporting.	$105,000		$5,888,918	(same)
Annual monitoring well inspections, evaluations, and reporting	$55,000		$3,084,672	(same)
5-year remedial action evaluation [c]	$100,000		$680,191	(same)
X-622 O&M	$925,000		$51,878,567	(same)
NPDES sampling	$3,231		$181,210	(same)
O&M of pumping wells	$25,000		$1,402,123	(same)
	Quadrant I: 5–Unit Groundwater Plume cost variance:		**$63,115,683**	**(same)**

Table 5.2. PORTS estimated cost variance [a] (continued)

Cost Element	Cost per Element	Year 1 (FY 2004)	Current Baseline End State [b]	ES Vision [b]
Quadrant II: X-701B Groundwater Plume				
Groundwater sampling and reporting	$85,000		$4,767,220	(same)
Annual monitoring well inspections, evaluations, and reporting	$10,000		$560,849	(same)
5-year remedial action evaluation (interceptor trench) [c]	$100,000		$680,191	(same)
5-year remedial action evaluation (oxidant injection) [c]	$100,000		$680,191	$0
X-624 O&M	$925,000		$51,878,567	(same)
X-624 Upgrade	$3,100,000	$3,100,000	$3,100,000	(same)
X-623 O&M	$925,000		$51,878,567	(same)
NPDES sampling	$6,461		$362,365	(same)
Interceptor trench O&M	$25,000		$1,402,123	(same)
Interceptor trench replacement	$4,300,000	$4,300,000	$4,300,000	(same)
O&M of pumping wells	$25,000		$1,402,123	(same)
Oxidant injection installation	$8,500,000	$8,500,000	$8,500,000	(same)
Oxidant injection O&M	$2,500,000		$140,212,344	$0
Cap installation	$3,304,000		$5,289,510	$0
Cap O&M	$6,000		$336,510	$0
	Quadrant II: X-701B groundwater plume cost variance:		**$275,350,863**	**$128,832,007**
Quadrant I: X-749/X-120 Groundwater Plume				
Groundwater sampling and reporting	$158,000		$8,861,420	(same)
Annual monitoring well inspections, evaluations, and reporting	$15,000		$841,274	(same)
5-year remedial action evaluation [c]	$150,000		$1,020,287	(same)
O&M of X-749 cap	$25,000		$1,402,123	(same)
O&M of X-749B (PK Landfill) cap	$25,000		$1,402,123	(same)
HRC application (3 application at $1M each)	$3,000,000	$3,000,000	$3,000,000	(same)

Table 5.2. PORTS estimated cost variance [a] (continued)

Cost Element	**Cost per Element**	**Year 1 (FY 2004)**	**Current Baseline End State [b]**	**ES Vision [b]**
Quadrant I: X-749/X-120 Groundwater Plume (continued)				
Phytoremediation tree replacement 2004 = 407 trees at $15/ea	$6,105	$6,105	$6,105	(same)
Phytoremediation tree replacement 2005 and beyond=167/yr and mowing	$60,000		$3,365,096	(same)
Quadrant I: X-749/X-120 groundwater plume cost variance:			**$19,898,429**	**(same)**
Cost variance between current baseline end state and ES Vision:			**$371,965,493**	**$225,166,212**
			Total cost differential:	**$146,799,280**

[a] All cost estimations based on PORTS Life-Cycle Baseline.

[b] Non-FY04 costs escalation projected 30 years at 4% per year.

[c] 5-year review costs escalation projected at 5% per every 5 years (6 events).

[d] Cap installation cost escalation projected at 4% per year for 8 years (construction estimated in FY 2012).

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FIGURES